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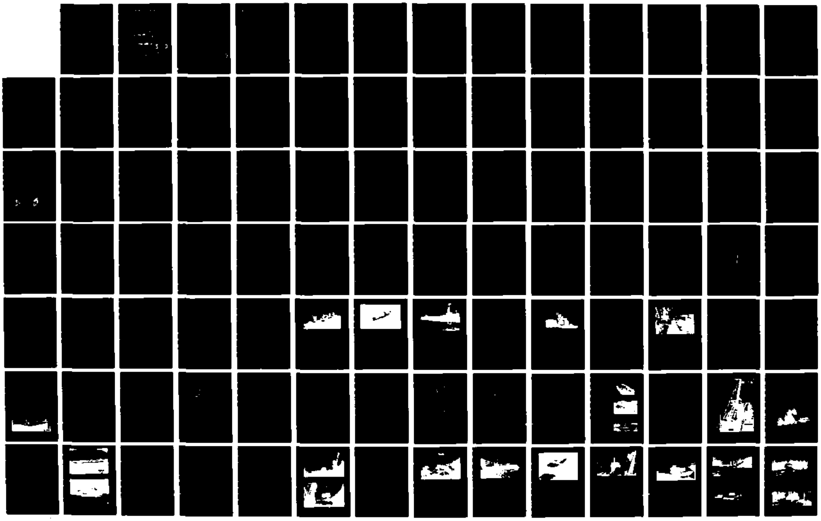

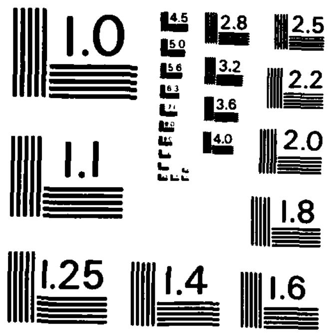

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DEPARTMENT OF DEFENSE

Joint Test Director

Joint Logistics Over-the-Shore II

Test and Evaluation

JOINT LOGISTICS OVER THE SHORE II ★ USAF · USA · USN · USMC ★

ANALYSIS AND EVALUATION REPORT

JLOTS II

Throughput Test

AUGUST 1985

ANALYSIS AND EVALUATION

JOINT LOGISTICS OVER-THE-SHORE II

JLOTS II

THROUGHPUT TEST

AUGUST 1985

Prepared by the

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DEPARTMENT OF DEFENSE

JOINT TEST DIRECTOR
JOINT LOGISTICS OVER THE SHORE (JLOTS II)
NAVAL AMPHIBIOUS BASE
LITTLE CREEK, NORFOLK, VA 23521

15 August 1985

To: Distribution List

Subj: JLOTS II Analysis and Evaluation Report--Throughput Phase

1. The subject report is approved for distribution.

2. This Joint Test Program examined many facets of logistics over the shore in an overall operational context. The detailed analysis of container, breakbulk, and bulk liquid cargo delivery operations contained in this report will give development, acquistion, and operational planners information upon which to base future decisions.

N. P. FERRARO

Rear Admiral, SC, U.S. Navy

Letter on file

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LIST OF ABBREVIATIONS

AAFS	Amphibious Assault Fuel System
AAFSF	Amphibious Assault Fuel Supply Facility
AAV	Amphibious Assault Vehicle
AB	Able-Bodied Seamen
ACB	Amphibious Construction Battalion
ACDS	Automated Cargo Documentation System
ACU	Assault Craft Unit
AFOE	Assault Follow-On Echelon
ALS	Amphibious Logistic System
AOA	Amphibious Objective Area
AOIC	Assistant Officer in Charge
ATTF	Amphibious Tanker Terminal Facility
BFTA	Bulk Fuel Tank Assembly
BMU	Beachmaster Unit
BRADC	Belvoir R&D Center
CATF	Commander, Amphibious Task Force
CL	Class
CLCC	Clearance and Lighter Control Center
CLF	Commander, Landing Force
CNO	Chief of Naval Operations
CNTR	Container
COMPHIBRON	Commander, Amphibious Squadron
CONUS	Continental United States
CP	Command Post
CPR-4	Commander, Amphibious Squadron Four
CSP	Causeway Section, Powered
CSS	Combat Service Support
CWF	Causeway Ferry
DASPS-E	Department of the Army Standard Port System - Enhanced
DRMO	Defense Reutilization and Marketing Offices
DWT	Deadweight Tons
EEA	Explosive Embedment Anchor
ELCAS	Elevated Causeway

FLS	Field Logistic Systems
FSS	Fast Sealift Support (Ship)
FSSG	Force Service Support Group
ISO	International Organization for Standardization
JLOTS	Joint Logistics Over-the-Shore
JTD	Joint Test Director
LACH	Lightweight Amphibious Container Handler
LACV-30	Lighter Air Cushion Vehicle, 30 Ton
LARC	Lighter Amphibious Resupply Cargo
LASH	Lighter Aboard Ship
LCC	Lighter Control Center
LCM	Landing Craft, Mechanized
LCU	Landing Craft, Utility
LFSP	Landing Force Shore Party
LO/LO	Lift-On/Lift-Off
LOGMARS	Logistics Applications of Automated Marking and Reading Symbols
LOTS	Logistics Over-the-Shore
LT	Long Ton
LTON	Long Ton
LVTP-7	Landing Vehicle, Tracked, Personnel, Model 7
LVTR-7	Landing Vehicle, Tracked, Recovery, Model 7
MACTDS	Marine Automated Cargo Throughput Documentation System
MAF	Marine Amphibious Force
MAGTF	Marine Air-Ground Task Force
MARAD	Maritime Administration
MCS	Modular Causeway System
MEP	Mobile Electric Power
MHE	Material Handling Equipment
MILVANS	Military ISO Containers
MLDD	Mooring Leg Deployment Device
MLMS	Multi-Leg Mooring System
MOMAT	Mobility Matting
MPS	Maritime Prepositioning Ships
MSC	Military Sealift Command

MSNAP	Merchant Ship Naval Augmentation Program
NAVCHAPGRU	Navy Cargo Handling and Port Group
NL	Navy Lightered
NM	Nautical Mile
NSS	Nonself-sustaining
OBFS	Offshore Bulk Fuel System
OIC	Officer in Charge
OPCON	Operational Control
OPORDER	Operations Order
OR	Operational Requirements
PCS	Primary Control Ship
PEA	Propellent Embedment Anchor
PHIBCB	Amphibious Construction Battalion
POL	Petroleum, Oil, Lubricants
PSI	Pounds Per Square Inch
QM	Quartermaster
RBTS	Rider Block Tagline System
ROWPU	Reverse Osmosis Water Purification Unit
RO/RO	Roll-On/Roll-Off
RRF	Ready Reserve Force
RTCH	Rough Terrain Container Handler
RTFL	Rough Terrain Forklift
SLWT	Side-Loadable Warping Tug
ST	Short Ton
STON	Short Ton
SUROB	Surf Observations
T-ACS	Auxiliary Crane Ship
T-AKR	Auxiliary Cargo Ship, Roll-On/Roll-Off
TCDF	Temporary Container Discharge Facility
TEU	Twenty-Foot Equivalent Units
TMPT	Tactical Marine Petroleum Terminal
TMT	Tactical Marine Terminal
TPT	Tactical Petroleum Terminal
USMC	United States Marine Corps
USN	United States Navy
WPA	Waterjet Propulsion Assembly

EXECUTIVE SUMMARY

PURPOSE OF JLOTS II

The Joint Logistics Over-the-Shore (JLOTS) II joint test and evaluation project was conducted to assess the Services' current capability in Assault Follow-On Echelon (AFOE) and Logistics Over-the-Shore (LOTS) operations.

JLOTS II OBJECTIVE

There are five Objectives to be assessed by JLOTS II.

1. Assess the capability to deploy, on designated commercial ships, selected outsized military equipment needed to conduct over-the-shore operations.

2. Assess the installation and preparation of over-the-shore systems and equipment for cargo operations.

3. Assess the over-the-shore systems and equipment capabilities for sustained container, breakbulk, vehicle, and bulk POL systems operations.

4. Assess the capabilities of the Services' to manage and control the movement of container and breakbulk cargo in sustained throughput operations over-the-shore.

5. Assess the capability of the Services' to transition from a Navy ALS/Marine Corps FLS operation to an Army LOTS operation.

TEST STRUCTURE AND COVERAGE

JLOTS II was separated into three test phases. Phase I, the Deployment Phase, covered Objective 1. Testing was conducted in May and July 1984, and the results are reported in the JLOTS II Deployment Phase[1*] report. Phase II, the Roll-On/Roll-Off (RO/RO) Phase, covered Objective 2 (installation) and Objective 3 (vehicle cargo throughput) requirements to address RO/RO ship unloading systems. Testing was conducted in July and September 1983, and the results are reported in the JLOTS II RO/RO Phase

*A Complete listing of references given on page 8-1

report.[2] Phase III, the Throughput Phase, covers the remainder of the test Objectives. Testing was conducted in September and October 1984, and the results are reported in this report.

TEST SITE

Fort Story, Virginia was selected as the site for the Throughput Test. It is near the Norfolk terminals where cargo can be loaded aboard the test ships. The probability of experiencing Sea State 3 conditions during a portion of the test period (a significant operational goal for most test systems, and rarely experienced in prior tests) was determined to be about 30 percent. The proximity to the Army Transportation Center, Fort Eustis, and the Naval Amphibious Base, Little Creek, Virginia, minimized the cost of transporting equipment to the test site.

TEST ORGANIZATION

The Joint Test Director acted as Unified Commander of assigned forces. This role facilitated test direction, and reflected a typical command structure. At the beginning of the test, Commander, Amphibious Squadron Four (CPR-4), in the role as Commander, Amphibious Task Force (CATF) established an Amphibious Objective Area (AOA). AFOE operations began in the AOA with elements of the Naval Cargo Handling and Port Group, Naval Beach Group Two, the U.S. Marine Corps (USMC) Second Landing Support Battalion (as Commander, Landing Force), and the USS RALEIGH participating. As the test progressed, the AOA was disestablished and CPR-4 became Commander, U.S Naval Forces, and Commander U.S. Forces, Country; Commander, Landing Force became Commander, U.S. Marine Forces Ashore, Country; and Commander, 7th Transportation Group arrived to become Commander, U.S. Army Forces, Country. Following transition, LOTS operations were then conducted with participation by the 11th Transportation Battalion, the 497th Engineer Company (Port Construction), and supporting Combat Service Support units. Commander, 7th Transportation Group was Service Senior Commander.

TEST SCHEDULE

The schedule for the Throughput Test is shown in Figure 1.

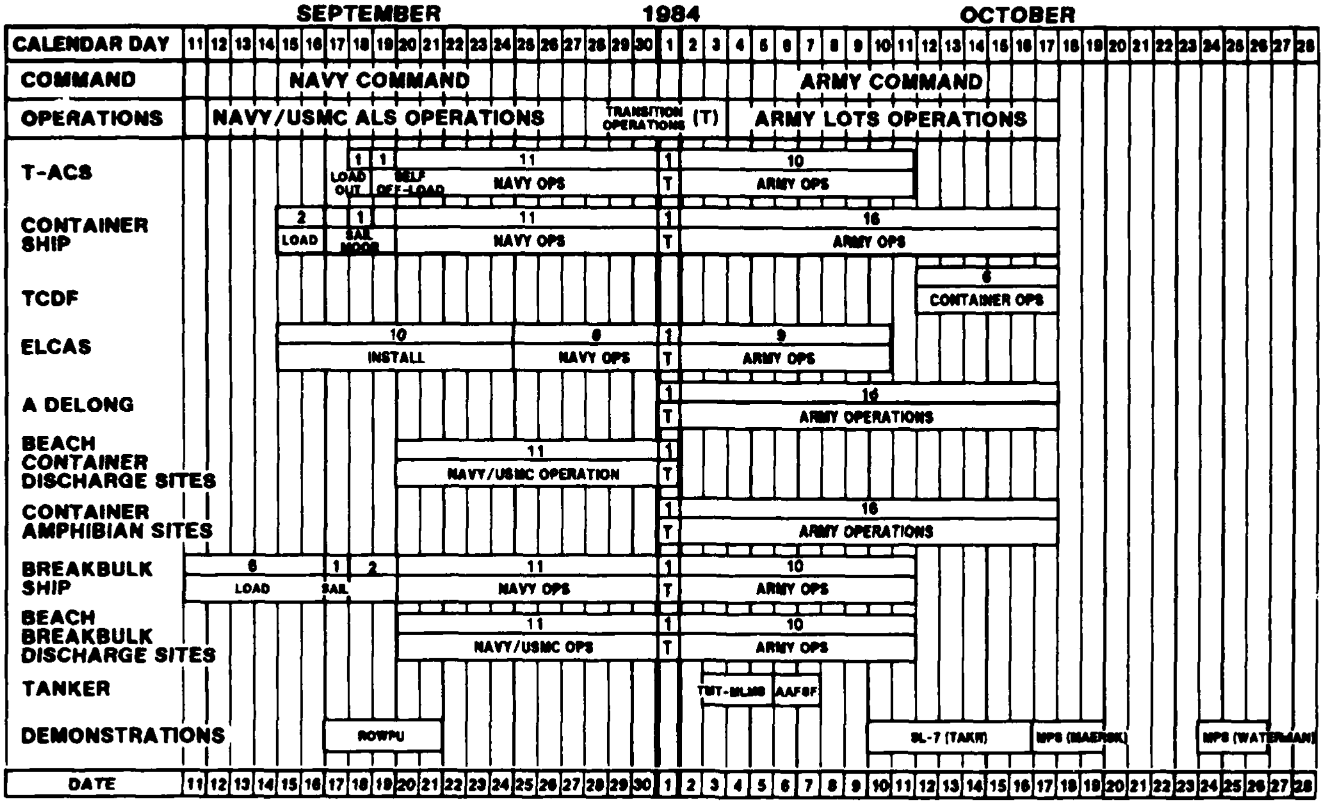


Figure 1 - Throughput Test Schedule

During the total test period, 1959 containers were offloaded from the containership and transferred to the Marshalling Yard. This limited number of container movements resulted from two major factors: container retrograde operations and weather/sea state limitations of the offload systems. The effect of these factors is illustrated in Figure 2.

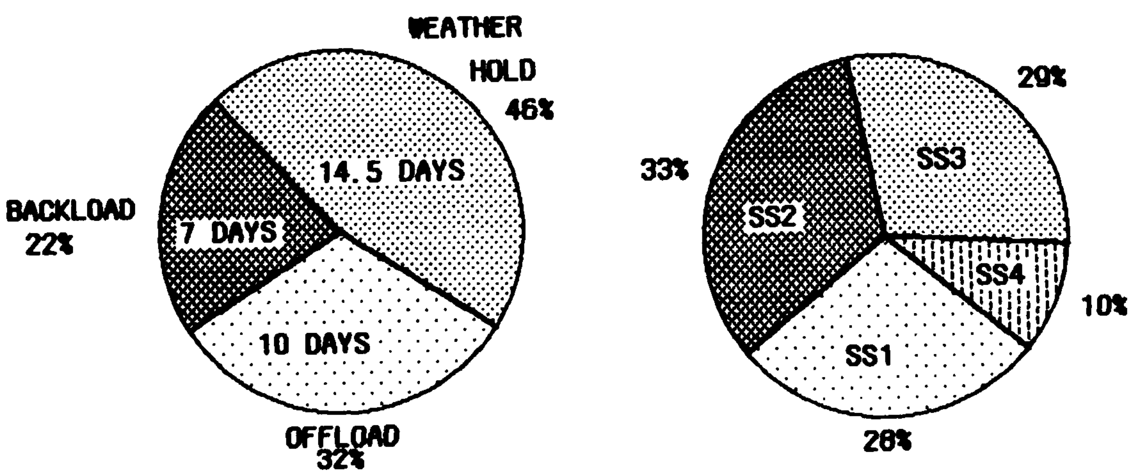


Figure 2 - Container Operations and Sea State Summary

NAVY/USMC PHASE

Navy/Marine Corps AFOE operations were conducted between 11 and 30 September 1984. Container movements are shown on Table 1. Container and breakbulk cargo offload operations began on 20 September. Offload of the breakbulk ship was completed on 23 September (1951 pallets) and containership offload (937 twenty-ft containers) was completed on 24 September. Weather delays and backloading operations consumed the remainder of the time.

Causeway Ferries (five configurations) were used as the primary lighter type with some additional employment of LCU's. The peak 10-hr offloading shift delivered 133 containers to the beach. The Navy operational commanders did not consider the accomplishments of the 4-1/2 day offload period to represent the capabilities of the Navy/USMC systems and, until defeated by later weather delays, had begun to plan a one-day maximum effort offload.

There were many minor delays, equipment problems, and procedural changes during the offload. Although Sea State 3 conditions existed during periods of the last four days of this phase, no attempt at container offload was made. The inability of lighters to operate was the primary reason, although there were times the T-ACS and ELCAS could not operate. Therefore, a Sea State 3 capability was not demonstrated.

TABLE 1 - CONTAINER MOVEMENT DURING NAVY/USMC PHASE

Date	Offload			Backload		
	Dayshift	Nightshift	Total	Dayshift	Nightshift	Total
20 Sep	92	97	189	-	-	-
21 Sep	133	82	215	-	-	-
22 Sep	114	100	214	-	-	-
23 Sep	105	114	219	-	-	-
24 Sep	100	-	100	16	62	78
25 Sep	-	-		105	78	183
26 Sep	-	-		109	-	109
27 Sep	-	-		16	-	16
28 Sep	-	-		32	25	57
29 Sep	-	-		-	-	-
30 Sep	-	-		-	-	-
TOTAL	544	393	937	278	165	443

Expected performance times for Navy/USMC container operations are shown in Table 2.

TABLE 2 - EXPECTED PERFORMANCE VALUES FOR NAVY/USMC SYSTEMS

Lighter	Lighter Capacity		T-ACS		Transit	Beach	
	Max Cntr	Cargo Wt Limit	Approach & Clear min	Load Time Per Container min (# booms)	Time-1 mi min	Approach & Clear * min (site)	Unload Time * min/cntr
CSP+1	10	125 ST	18	12 (1) 8 (2)	22	20 (R)	3 (R)
CSP+2	20	215 ST	24	12 (1) 5 (3)	24	44 (R)	3 (R)
CSP+3	30	305 ST	28	12 (1) 4 (4)	26	44 (R)	3 (R)
3-Section Unpowered Causeway Ferry	23	270 ST	22	12 (1) 4 (4)	28	52 (R)	3 (R)
LCU-1600	5	168 LT 188 ST	14	9 (1) 6 (2)	20	12 (L) 7 (E)	9 (L) 9 (E)

*R = RTCH Beach (2 RTCH per Causeway Ferry)
L = LACH Beach (2 LACH per LCU)
E = Elevated Causeway

Offshore Operations

Navy offshore operations began with the preparation and self-offload of the T-ACS. Delays occurred because of hurricane watch forecasts for the first few days of the period and because of weather and sea conditions late in the period. Offshore operations were not affected by sea conditions through Sea State 2, but ceased almost entirely at the onset of Sea State 3.

T-ACS Preparations and Self-offload. The civilian ship's force prepared the T-ACS for operations in 10 hr of activity on 14 and 15 September.

T-ACS self-offloaded an LCM-8 and an unpowered causeway section from deck stowage and various equipment from below deck stowage in SEASHEDS. Preparation and offload of the LCM-8 was done in 1-1/2 hr using booms 3A and 3B in a twin mode. Preparation and offload of the unpowered causeway section was done in 2 hr. These deck loads were handled easily in calm sea conditions. The intended lift of a Causeway Section, Powered (CSP) was not conducted because the CSP, at 102 tons, exceeded the working load certification of tandem crane (1A and B and 2A and B) operations (95 tons). It is recommended that the cranes be recertified (redesigned, if necessary) for lift of a Side-Loadable Warping Tug (SLWT) plus a 10 percent reserve for variation in the weight. Twenty-foot units of the Modular Causeway, fenders, rider blocks, rigging equipment, and other miscellaneous items were offloaded from SEASHEDS with no problems.

The Rider Block Tagline System installed on T-ACS cannot be used when the crane booms are used in combination. This is considered a deficiency since pendulation control is essential when handling heavy loads as well as when handling containers.

T-ACS/Containership Mooring. The SS EXPORT LEADER, a containership in the Ready Reserve Force, was used in an unactivated condition for the test. It was moved to the test site by two commercial tugs that also assisted to positioning it alongside the T-ACS. Mooring was completed in 2 hr. Ten-foot diameter fenders were used between the ships. At this separation the horizontal beams of the Rider Block Tagline System and the T-ACS bridge wing extended over the containership. No ship-to-ship contact occurred during the test, but the condition is not satisfactory. The 14-1/2 ft diameter fenders that are available were not used, but also may not provide adequate separation.

A separate T-ACS/containership mooring without tug assistance was planned, but never accomplished because of safety considerations. This alternative should be pursued since the procedure used in the test would require deployment of tugs that otherwise may not be needed or available.

Lighter Maneuvering at T-ACS. The Causeway Ferries used by the Navy varied in length from 180 ft to 360 ft. The 180-ft ferry could operate at any one of the three mooring stations. The longer ferries were used at the two forward stations where one ferry occupied the two stations. A procedure was developed during the test where a long ferry (CSP plus 2 or 3 unpowered sections) would moor at the T-ACS lighter mooring stations with another ferry moored outboard of the first. Containers would be loaded on the outboard lighter first and only on the inboard lighter when space was not available on the outboard one. The net result was fewer interruptions to the crane operation resulting from lighter mooring and cast-off. Mooring time per lighter was the same for the new procedure as for single lighter positioning. One ferry contained the 24-ft wide Modular Causeway Section, and it was found that this ferry consistently would cast-off and clear the T-ACS much faster than the others. The apparent reason was that it was easier for the crew to move fore and aft around transversely loaded containers to mooring line locations on the wider Section.

LCU's moored to T-ACS in a "Chinese" orientation to keep their deck house away from the path of swinging containers. This required a down-current approach which is more difficult than upcurrent.

The H-Fenders at the lighter stations were too short and would ride up on the Causeway Ferries. Mooring line arrangements were not standard for all lighters and caused minor delays and confusion. Lighter mooring is sea state sensitive and, generally, was not attempted in Sea State 3.

Lighter Loading at T-ACS. During the Navy/USMC Phase, pendulation of the T-ACS remotely operated container spreader bars was found to be uncontrollable under the slightest ship roll condition (less than 1 deg). Army manual spreaders were acquired and tried, as were single point lift, four-leg slings. The slings soon became the preferred equipment.

Test data for Causeway Ferry loading was examined to determine if there was any interaction between the two booms on a crane pedestal. It was found that each boom had a 16-min cycle when both booms were handling containers, and that the cycle was 12 min when only one boom was operating.

Containership hatch cover moves, either opening or closing, averaged one hour each.

The Rider Block Tagline System as installed and operated on T-ACS-1 did not control container pendulation which was more pronounced when ground swells approached from the beam. Alternatively, as wave height increased, lighters had more difficulty mooring when the T-ACS port side (lighter mooring side) was not in the lee. It has been recommended that a two-point mooring be investigated for T-ACS to ensure a lee for lighters.

Lighter Transit

Navy lighters experienced little or no difficulty transiting to the beach area. The final approach to the Rough Terrain Container Handler (RTCH) and Lightweight Amphibious Container Handle (LACH) offloading sites, included in the transit time for data purposes, was affected by current and, at low tide, by sandbars. For many reasons, including administrative, weather, and occupied offloading sites, lighters were not consistently ordered to proceed directly to the beach. The resulting data contained obvious inconsistencies and does not reflect expected operational transit capabilities. The transit times given in Table 2 have been adjusted to reflect the judgement of expert observers.

Beach and Onshore Operations

Navy lighters were offloaded at two beach facilities: Causeway Ferries at the RTCH site and LCU's at the LACH site. The Elevated Causeway (ELCAS) installation was not completed in time to be used during the Navy/USMC ship offload.

Beach Facility Installation. Although beach preparation was a test objective, it was done with an administrative rather than operational plan. Preparation began on 10 August 1984 and was done under Joint Test Directorate and Army direction with major participation by civilian personnel and equipment from Fort Story Public Works Department. Army personnel performed some of the work including manual labor. The major elements of beach preparation were installation of 9000 ft of Sand Grid roadway in a "race track" configuration on the beach, and 7000 ft of MOMAT serving as roadway extensions and truck loading and passing zones at the cargo offload sites. The roadway system gave generally good performance.

Wear requiring repair occurred in Sand Grid turns and where sand was easily displaced under MOMAT.

RTCH and LACH sites required essentially no preparation. Lighter approach operations at these sites could have been improved by the installation of a better system of range markers and lights.

Prior to JLOTS II, ELCAS installation had been stated to require three days. During JLOTS II planning, based partly on the results of the Deployment Test that identified the deployment configuration of some of the ELCAS components, an estimate of five days was developed. Actual installation was accomplished over a ten-day period that was interrupted by three days of bad weather (Sea State 2-3 and winds over 20 knots). The ELCAS included twelve causeway sections. These sections, and five additional ones, were loaded with ELCAS components and installation equipment at the Naval Amphibious Base in arrangements convenient for installation. Even so, some equipment, including the container handling crane, was transported administratively to the test site. The ELCAS installation team was made up of personnel from more than one Amphibious Construction Battalion. Procedures and management coordination reflected a lack of detailed preplanning and coordination. For current planning purposes, a seven-day installation time should be used for installation of a twelve section ELCAS.

Lighter Maneuvering at the Beach. Lighters transited directly to the RTCH and LACH sites. Once beached, Causeway Ferries were generally hauled further up with two dozers, and the hinged vehicle ramps were lowered for RTCH access. Following container offload, the procedures for Causeway Ferry cast-off included use of a forklift to lift the vehicle ramps and dozers to push the ferry off the beach. These procedures were slow, resulting in maneuvering times longer than expected prior to the test. LCU maneuvering at the LACH site was generally efficient. At low tide, sandbars slowed the lighter clearing the beach.

Lighter Unloading at the Beach. Two RTCH's were used to unload a Causeway Ferry and two LACH's unloaded an LCU. The RTCH operation was significantly faster than the LACH operation. Container cycle times are given in

Table 2. Procedures were well developed, and training and operator proficiency was very good.

<u>Marshalling Yard Operations</u>. Truck-trailers carrying one container were offloaded by RTCH or a 30-ton crane in an average of 3 min. Containers were placed in turret stacked (alternating 1 and 2 tier arrangement) rows.

Breakbulk Operations

The breakbulk ship was prepared for offload by its crew. Stevedoring equipment lockers were not stocked with the items expected and required supplement by Navy Cargo Handling and Port Group. Fenders for the lighters were provided by the Navy Assault Craft Unit. Fenders for administrative and personnel craft arriving at the ship's accommodation ladder became a problem, solved well into the test schedule by the shipyard contractor supporting the ship.

In 3-1/4 days, 1951 pallets were offloaded with no impact on container operations. LCM-8 and LCU lighters were used, making a total of 68 lighter trips to the beach. LCU's were preferred because they were large enough to permit use of a forklift in the lighter to move pallets from the drop point. Forklifts (6000- and 4000-lb capacity) were used at the beach for lighter offloading, with the 6000 lb units preferred. Damaged pallets were repaired at the beach. A repair capability should also be established in the Marshalling Yard.

Bulk Liquid Operations

Navy and Marine Corps bulk liquid systems tested were the Amphibious Assault Fuel Supply Facility (AAFSF) for ship-to-shore delivery and the Amphibious Assault Fuel System (AAFS) for ashore storage and distribution.

<u>AAFSF</u>. The AAFSF was installed by a composite team of Amphibious Construction Battalion personnel in two days. Installation was hampered by currents which deflected the hoseline and resulted in more hose being deployed than expected. Installation procedures were not well established or understood. After installation, 275,000 gal of water were transferred from the tanker to three AAFSF bladders, with 169,000 gal being delivered ashore in a two-day period. This is well short of the goal of 440,000 gal

per day for the system. The system currently does not have lights for night operations.

AAFS. One-sixth of an AAFS, seven 20,000 gal storage bags and two pumps, were installed by a highly trained crew in 14 hr. The location was vulnerable to high storm tides, so the installation was removed and replaced by three Army 50,000 gal bags, which received the water delivered by the AAFSF and transferred a portion on to other storage facilities. No problems were identified in AAFS operations.

Control and Documentation

Navy/USMC Command Control was established under the Commander, Amphibious Squadron Four. The USS RALEIGH was used as a Primary Control Ship. The structure functioned well. A Lighter Control Center was established aboard the T-ACS, and was considered critical to a successful operation. Weather delays and fatigue combined to deteriorate the motivation of Navy operators. The command organization did not respond in a constructive way to this.

Marine Corps cargo documentation and control was provided by the current manual system and in parallel by the Marine Automated Cargo Throughput Documentation System (MACTDS). Both systems worked well. MACTDS has the potential for more thorough and timely information on cargo status and location. It is recommended that MACTDS be able to interface with the Army DASPS-E.

TRANSITION PHASE

The transition from a Navy/USMC operation to an Army operation was generally planned to be phased over a four-day period. The JLOTS II Throughput Test Field Test Plan outlined such a procedure. The Navy Operation Order addressed the phased transition in a general way. The Army Operation Order identified specific events and schedules for the transition. Adverse weather and sea conditions, existing as the date for initiating transition approached, disrupted Navy operations and prevented a phased transition. The result was a single event transition that occurred on 1 October 1984. Navy and Marine Corps operations, which had been at a standstill for weather and sea state reasons, were immediately terminated.

The single event transition may be the most effective and manageable approach in situations where the Army is able to install its facilities prior to activation.

ARMY PHASE

Army LOTS operations were conducted between 1 and 17 October 1984. Container movements during the period are shown in Table 3. Breakbulk

TABLE 3 - CONTAINER MOVEMENT DURING ARMY LOTS OPERATIONS

Date	Offload			Backload		
	Dayshift	Nightshift	Total	Dayshift	Nightshift	Total
1 Oct	-	-	-	32	-	32
2 Oct	-	-	-	21	55	76
3 Oct	-	-	-	104	91	195
4 Oct	91	132	223	-	-	-
5 Oct	125	84	209	-	-	-
6 Oct	11	-	11	-	-	-
7 Oct	105	-	105	-	151	151
8 Oct	-	-	-	157	132	289
9 Oct	187	117	304	-	-	-
10 Oct	95	-	95	-	-	-
11 Oct	-	-	-	-	-	-
12 Oct	-	-	-	-	-	-
13 Oct	-	-	-	-	-	-
14 Oct	-	-	-	-	-	-
15 Oct	-	3	3	-	-	-
16 Oct	27	27	54	-	-	-
17 Oct	18	-	18	-	-	-
TOTAL			1022			743

cargo offload operations began on 4 October. Five 10-hr shifts of breakbulk offload were accomplished.

Container offload operations using the T-ACS were conducted in two cycles; 4-7 October and 9-10 October. The Army typically operated in short periods of concentration on a particular lighter type. The most prominent of these periods was a 10-hr shift on 9 October when LACV-30 lighters, operating as a single lighter type, offloaded 187 containers. None of the

periods could be considered to constitute "sustained" operations. As in the Navy/USMC test period, Army systems did not demonstrate a Sea State 3 capability. The LARC-LX operated to transfer personnel in sea conditions beyond those in which any other lighter operated.

Expected performance times for Army container operations are shown in Table 4.

TABLE 4 - EXPECTED PERFORMANCE VALUES FOR ARMY LOTS SYSTEMS

Lighter	Lighter Capacity		T-ACS		Transit	Beach	
	Max Cntr	Cargo Wt Limit	Approach & Clear min	Load Time Per Container min (# booms)	Time-1 mi min	Approach & Clear * min (site)	Unload Time * min/cntr
LACV-30	2	23 ST	9	7 (1) 4 (2)	8	2 (A)	3 (A)
LCU-1600	5	188 ST	14	9 (1) 6 (2)	20	8 (D) 7 (E)	6 (D) 9 (E)
LCU-1466	8	187 ST	22	9 (1) 6 (2)	20	14 (D) 8 (E)	8 (D) 9 (E)
LARC-LX	2	60 ST	9	6 (1) 4 (2)	15	1 (A)	3 (A)

*A = Amphibian Discharge Site
D = DeLong Pier
E = Elevated Causeway

Offshore Operations

Army offshore LOTS operations began with container backloading on 1 October at the T-ACS. The only installation or preparation required was the establishment of the Army Lighter Control Center aboard the T-ACS, and this was done in minimal time since the requirements were austere.

Offshore operations were not affected by sea conditions through Sea State 2, but ceased almost entirely at the onset of Sea State 3.

Lighter Maneuvering at T-ACS. Adverse weather and local tidal currents caused difficulties mooring lighters to the T-ACS. Moorings were always easier when performed on the lee side. Additional factors that affect mooring operations include:

- Confusion on the part of craft masters regarding the precise mooring location at a given station,
- The curvature of the T-ACS hull at the forward station, and
- The requirement for LCU-1600 Class to moor with its deck house outboard.

Loaded lighters were generally able to cast-off and clear the T-ACS mooring stations without difficulty. There was no noticeable difference in cast-off and clear times between the T-ACS mooring stations, and the LACV-30 and LARC-LX were faster than the LCU.

Lighter Loading at T-ACS. During the Army LOTS operations, four-leg slings were used in lieu of spreader bars for lifting containers at T-ACS. Operations with slings was more productive than with spreader bars because the slings could be attached to the container individually without the precise alignment of a heavy spreader bar.

During the 10-hr period of concentration on LACV-30 lighters, a routine for container transfer developed. At the two forward T-ACS lighter mooring stations, the two crane booms at a station would each lift a container from the containership, swing around, and suspend the containers over the T-ACS deck while a loaded lighter departed the station and an empty one arrived. Once the incoming lighter was moored, first one boom would lower its container to the lighter, then the other. This routine produced efficient T-ACS crane cycles for loading a two container capacity lighter.

TCDF Operations. The two TCDF's were towed to the containership by Army 100-ft tugs. Mooring was completed for each in about 15 min.

Container offload operations were conducted during four shifts on 15-17 October in Sea State 2 conditions. A total of 75 containers were offloaded. In addition to the sea state, this low throughput was attributed to a lack of motivation caused by command attention having been

diverted to a "not to interfere" demonstration of the Fast Sealift Support Ship (TAKR).

Lighter Transit

Army lighterage experienced little or no difficulty transiting to the beach. However, data for transit time was confused by the fact that some lighter trips (particularly LCU trips) were interrupted for various administrative or weather delays, and the data collection procedures could not account for such events. During analysis, the obvious data outliers were eliminated, but the remaining data, although grouped in essentially normal distributions, have mean values higher than are usually projected for these operations. The conclusion reached is that the transit times reported for Army lighters do, in fact, represent operationally realistic values for the personnel and equipment used in the test.

Beach and Onshore Operations

Army lighters were offloaded at three beach facilities: the DeLong Pier; the Elevated Causeway (ELCAS); and the Amphibian Discharge Site. Containers were transferred to Yard Tractor/Trailer vehicles by cranes directly, or in combination with Rough Terrain Container Handlers (RTCH).

Beach Facility Installation. The ELCAS was installed by Navy personnel prior to Army test operations. No further installation or preparation was required for its use.

The two sections of a DeLong Pier consisting of one A-unit (80 ft x 300 ft) and one B-unit (60 ft x 150 ft) were towed separately to the test site with caissons already installed in the jacks. Once positioned at the beach, each unit required one hour to elevate. Installation of the beach ramp was accomplished using a crane on the pier and another crane on the beach. Ramp placement was repeated several times because of erosion of the abutment during high tides. Both foam-filled cylindrical fenders and used RTCH tires were tried for lighter fendering, with the tires giving better performance. Two 140-ton cranes were positioned on the A-unit (seaward) to service lighter berths on either side of the pier.

The Amphibian Discharge Site consisted of a horseshoe shaped sand berm at the water's edge with the open side facing seaward. Two 140-ton cranes

served the two lighter unloading locations at the site. Constant maintenance was required to maintain the site level for LACV-30 operations.

Lighter Maneuvering at the Beach. Lighter maneuvering at the beach normally includes the approach and moor, and cast-off and clear operations. Amphibian lighters however, made a direct transit to the Amphibian Discharge Site, so there is no approach and moor time in this case.

Maneuvering to and from the DeLong Pier and the ELCAS proved difficult for the craft masters. A lack of training and experience in seamanship contributed to making it difficult. The analysis of lighter maneuvering data produced a slower than expected result. The results are considered to reflect current capabilities with the present equipment and personnel.

Lighter Unloading at the Beach. LCU's were offloaded at the ELCAS by the 140-ton crane using a manual spreader bar. Containers were placed directly onto truck-trailers. The truck traffic pattern used caused a truck being loaded to block the next truck's way to the turntable thus delaying that truck's arrival at the loading spot. Crane operations were suspended in wind speeds above 20 knots.

LCU's were also offloaded at the DeLong Pier by 140-ton cranes, and containers were placed directly onto truck-trailers using manual spreader bars. The 20-knot wind limitation also applied.

LACV-30's and LARC-LX's were offloaded at the Amphibian Discharge Site. Containers were usually placed on the ground by the 140-ton cranes and later loaded onto truck-trailers by RTCH's. Higher transfer rates were achieved at this facility than at the other two locations.

Marshalling Yard Operations. Truck-trailers carrying 2 containers were offloaded by RTCH's in an average of 3 min. As in Navy/USMC operations, containers were placed in turret-stacked rows. The operation was smooth and efficient.

Breakbulk Operations

In five 10-hr shifts, 1308 pallets were offloaded from the breakbulk ship. No problems were experienced at the ship. LCM-8 and LARC-LX lighters were used. The movement of breakbulk lighters crossed the lanes

of the container lighters, but no interference was detected. Cargo was unloaded from the lighters at the beach and transferred to trucks by rough terrain forklifts. Similar forklifts were used in the Marshalling Yard. Breakbulk operations were generally problem free. Pallets were frequently dropped and broken, resulting in the establishment of a pallet repair activity on the beach.

The overall conclusion is that breakbulk operations did not interfere with container operations.

Bulk Liquid Operations

Army bulk liquid systems involved in JLOTS II were the barge mounted Reverse Osmosis Water Purification Unit (ROWPU), the Tactical Marine Terminal, and the Multi-Leg Mooring System.

ROWPU. The ROWPU was installed two times in JLOTS II because the first installation was limited by rough weather and crew performance. The second installation was accomplished in 4-1/2 hr. The supporting 17-ft boat is difficult to launch, and has limitations for handling the line required to be taken ashore for hoseline installation.

In operation, the ROWPU averaged 228,000 gal per day production instead of the 300,000 gal per day goal. Several breakdowns occurred in the chlorination system. Sea State 2 conditions existed during part of the operating period, and this may have affected operations or the crew's ability to maintain the system due to the barge's tendency to roll severely.

Tactical Marine Terminal (TMT). The Tactical Marine Terminal deployed for JLOTS II consisted of a 6-in. floating hoseline, a 6-in. steel bottom-lay pipeline, a spread mooring/anchorage of four drag embedment anchors, and a shoreside storage and delivery system called the Tactical Petroleum Terminal (TPT).

Installation of the TMT included so many problems and failures that it cannot be summarized easily. The interested reader should refer to Section 5.1.3.2 of the report. The TPT system was the exception, one basic module of which was installed by a highly trained crew in 3-1/5 hr.

Operation of the TMT resulted in 150,000 gal of water being pumped ashore through the 6-in. floating hoseline (which had sunk because of leaks prior to pumping operations). The TPT was exercised with water that had been stored ashore for other training.

Multi-Leg Mooring System (MLMS). Installation of the MLMS also had so many problems and failures that it was not used during JLOTS II. Refer to report Section 5.1.3.3.

Control and Documentation

Army Command Control was established under the Commander, 7th Transportation Group. The structure generally functioned well except for the supporting Engineer and Quartermaster units which were not well integrated into the command relationship. Lighterage control at times lacked coordination to the extent that the LCC aboard T-ACS often did not know the status of lighters that were scheduled as part of the operation. Command attention was diverted from JLOTS II objectives by VIP visits and the TAKR demonstration.

Army cargo documentation was accomplished by a combination of the Automated Cargo Documentation System (ACDS) and the Logistics Applications of Automated Marking and Reading Symbols (LOGMARS). This was in lieu of the Department of Army Standard Port System (DASPS-E) which was not available. Since the DASPS-E is the system of interest, evaluation of ACDS and LOGMARS is somewhat academic.

CONCLUSIONS

The overall conclusions are presented for each test Objective.

Objective 1 - Deployment

The conclusions from the Deployment Test are presented in the JLOTS II Deployment Test Report.

Objective 2 - Installation and Preparation

Vehicle Cargo Systems. Installation and preparation of the RO/RO Discharge Facility, for delivery of vehicular cargo was reported in the JLOTS II Roll-On/Roll-Off Ship Operations Report dated 19 March 1984.

Container and Breakbulk Cargo Systems. The Auxiliary Crane Ship (T-ACS), Temporary Container Discharge Facility (TCDF), Breakbulk Ship, and lighters can be prepared for operations in less than a day by the operating units. A number of recommendations are made in Section 3.2.1.1.5 for T-ACS improvements.

Beach and Marshalling Yard preparation, although a test objective, was performed administratively. No assessment of service capability was possible.

Installation of lighter offload facilities at the beach is assessed well within the Services' capability with two exceptions; the DeLong Pier, and the Elevated Causeway. The DeLong Pier installation is limited by the fact that there was no demonstrated capability to insert the caissons in the jacks in the operating area, and deployment of the DeLong Pier with caissons installed was judged infeasible. Installation of the Elevated Causeway was accomplished by the Navy, but not within the expected time or with all components arriving in a deployment configuration.

Installation of cargo documentation systems was performed quickly and efficiently.

Bulk Liquid Systems. Installation of the Amphibious Assault Fuel Supply Facility (AAFSF) was accomplished by the Navy in two days with difficulty. Lack of training and experience was the major problem. Installation of the USMC Amphibious Assault Fuel System (AAFS) can be accomplished quickly and efficiently by well trained crews. One-sixth of a system was installed in 14 hr.

The Army attempts to install an operational bulk fuel system were not successful. Material condition of equipment was poor, and personnel were not well organized or trained.

Objective 3 - Cargo Throughput

Vehicle Cargo Systems. The performance of vehicular cargo throughput systems was reported in the JLOTS II Roll-On/Roll-Off Ship Operations report of 19 March 1984[2].

Container and Breakbulk Cargo Systems. The over-the-shore systems and equipment capabilities for **sustained** container and breakbulk systems operations were never really tested. The 4-1/2-day Navy/USMC offload operation was broken by numerous equipment changes and delays and procedural changes. A sustained condition never existed. Army offload operations were segmented into short periods that also never achieved a sustained state.

A sustainable, productive Sea State 3 capability does not exist. Limiting elements are lighter capability, T-ACS load pendulation and lighter mooring, and ELCAS/DeLong lighter mooring and crane/wind limitations. Productivity is not affected by sea conditions through Sea State 2.

The T-ACS self-offload is limited by the 95-ton certified working load rating for heavy lifts. This does not permit handling the Causeway Section, Powered (CSP) or the Side-Loadable Warping Tug (SLWT). Cargo offload from SEASHEDS is easily accomplished in calm seas. The total lack of load pendulation control for heavy lifts, and the poor performance of the system for control of containers is a deficiency. Many equipment and arrangement recommendations for T-ACS are contained in the body of the report.

T-ACS-1 can transfer in excess of 300 containers per day in calm seas when all its cranes have access to a supply of containers on the containership, and when supplied with lighterage without delay. As containership unloading proceeds, cranes will begin to deplete their supply and individually phase out of operation. As this occurs, the T-ACS daily transfer rate will drop.

Containers used in JLOTS II did not include the percentage of heavy units that is expected in actual operations. The impact of this is that Causeway Ferries and LACV-30's carried a higher average number of containers than should be expected. Productivity projections presented in this EXECUTIVE SUMMARY are based on use of a containership of the SS EXPORT LEADER Class (the JLOTS II containership), but loaded with 928 containers, 29 percent of which are heavy. LACV-30 carries only one heavy container, and the Causeway Ferry carries only four per unpowered section.

The Causeway Ferry was demonstrated to be an excellent container lighter in less than State 3 seas. The T-ACS : Ferry : RTCH system productivity is illustrated in Figure 3.

The LACV-30 as the only high speed amphibian lighter in JLOTS II, presents unique capabilities for long transits and ashore unloading. The T-ACS : LACV-30 : Crane system productivity is illustrated in Figure 4.

Bulk Liquid Cargo. The Navy/USMC combination of AAFSF and AAFS did not achieve the productivity goal of 440,000 gal per day. Operations were limited by lack of training, management, and a nighttime capability.

The Army did not demonstrate a capability to transfer cargo from a tanker to the beach.

Objective 4 - Cargo Management and Control

Cargo management and control systems operated in JLOTS II were not representative of the Service intended capability. The USMC manual system, although operated in the test, is obsolete in view of the potential of

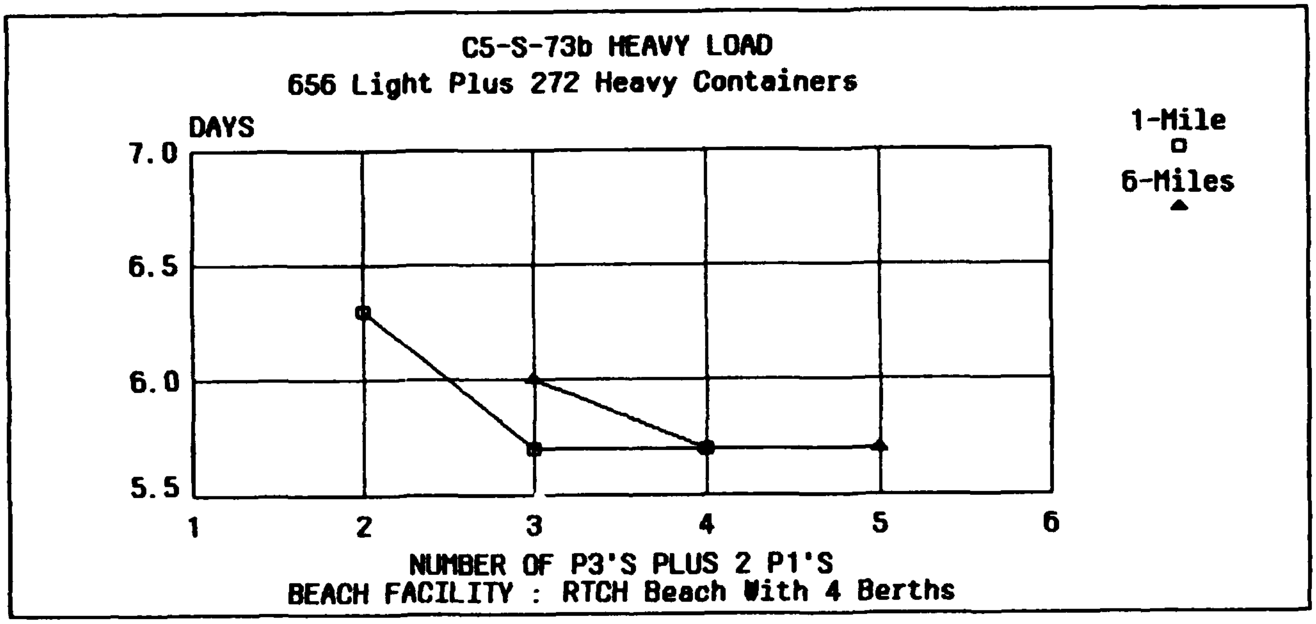


Figure 3 - T-ACS : Causeway Ferry : RTCH System Productivity

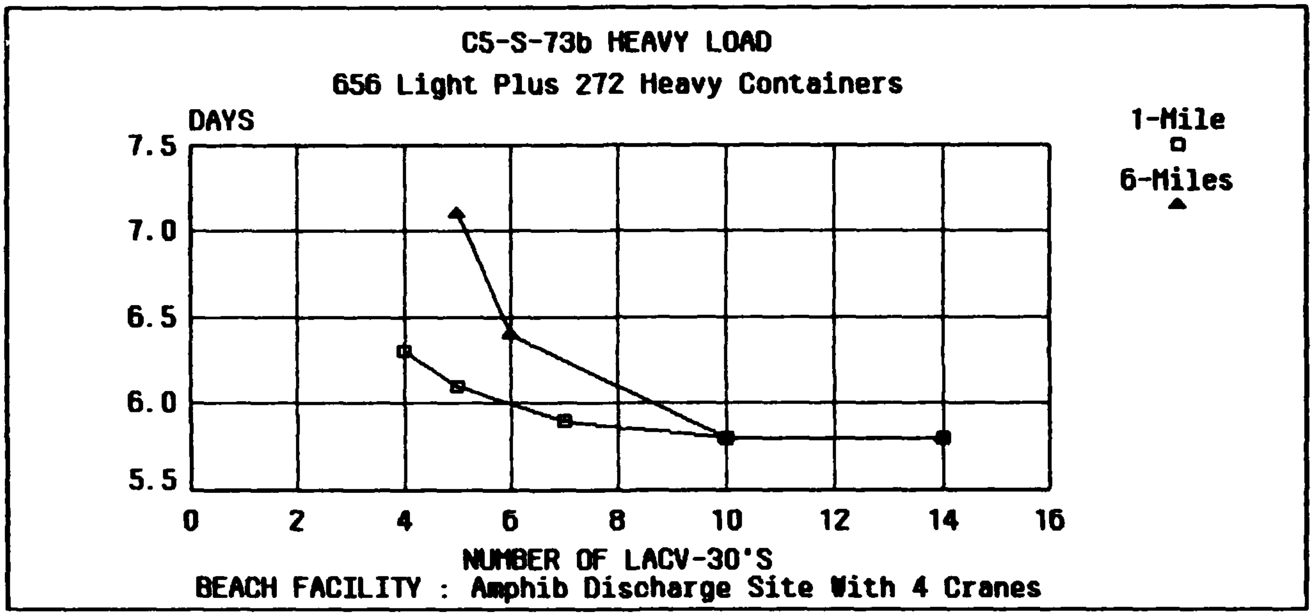


Figure 4 - T-ACS : LACV-30 : Crane System Productivity

MACTDS. The Army DASPS-E is being fielded, but was not available for JLOTS II.

Objective 5 - Transition

A four-day phased transition was envisioned in pretest planning, but a single event transition was carried out. The single event was easier to implement and should be considered when applicable in the future.

1.0 INTRODUCTION

1.1 BACKGROUND

In the future, 90 to 95 percent of the supplies and equipment required by operating military forces will be transported in strategic sealift made up of modern merchant vessels. The supplies will be containerized to the extent possible, and the containerships will be nonself-sustaining for the most part. When the military operations are conducted in areas where port facilities for containerships are not available for either military or geographic reasons, the supplies and equipment must be brought ashore in Logistics Over-the-Shore (LOTS) operations.

The Joint Logistics Over-the-Shore (JLOTS) II joint test and evaluation project was conducted to assess the Services' current capability in Assault Follow-On Echelon (AFOE) and Logistics Over-the-Shore (LOTS) operations. This is the latest in a series of joint tests begun in 1970 to aid the development and to demonstrate container handling capability in AFOE/LOTS operations. JLOTS II was separated into three test phases. Phase I, the Deployment Test, was to assess the capability to deploy the logistics delivery equipment in merchant ships to the operating area. Phase II, the Roll-On/Roll-Off (RO/RO) Test, was to assess the capability to assemble, install, and operate an offshore RO/RO Discharge Facility and to deliver vehicular cargo ashore from merchant RO/RO vessels. Phase III, the Throughput Test, was to assess the Services' capability to install and use their delivery systems for container, breakbulk, and bulk liquid cargo, and to define the operating performance of the combined systems in a joint test.

The Deployment Test[1] was conducted in May and July 1984. The RO/RO Test[2] was conducted in July and September 1983. The Throughput Test is reported in three documents: A Quick Look Report[3]; An Operational Report[4]; and this report, the Analysis and Evaluation Report.

1.2 SCOPE AND OPERATIONAL CONTEXT

The context for the test scenario starts with the assumption that a Navy/Marine Corps amphibious assault has been conducted. The Assault Echelon, transported mainly on Naval shipping, has succeeded in securing a

beachhead, and the AFOE is arriving on merchant ships. The AFOE equipment and supplies are in the form of container, breakbulk, and bulk liquid cargo. Port facilities are not available for offloading this cargo, so over the beach operations are necessary. This requires use of elements of the Navy's Amphibious Logistics System (ALS), and the USMC Field Logistics System (FLS). It is assumed that the ships transporting the ALS and FLS equipment have arrived and have discharged their cargo, but that nothing has been installed. (This transport and ship discharge evolution was the subject of the Deployment Test). Thus the Throughput Test starts with the installation and preparation of ALS and FLS equipment. Once operating, the systems function to move cargo from the strategic sealift ships to lighters and then ashore to a logistics support area.

The operational context continues with the assumption that after a period of Navy and Marine Corps operation, Army forces begin to arrive and, following a transition period, the operation becomes totally an Army one. Again, there is an assumption that ships transporting the Army LOTS equipment have arrived and discharged their cargo. Installation and preparation of the LOTS equipment, therefore, is within the context of the Throughput Test. Operation of the Army LOTS system also required the movement of cargo from ship holds, over the beach, and to a Marshalling Yard.

1.3 JOINT TEST OBJECTIVES

There are five primary Objectives for JLOTS II. These were articulated in the JLOTS II Test Design[5]. Each Objective is expanded into two or more Subobjectives. The exact statement of the Objectives and Subobjectives is given below. The Subobjectives addressed in the Deployment and RO/RO Tests, and reported in the reports of those tests[1,2] are so annotated.

Objective 1

Assess the capability to deploy on designated commercial ships selected outsize military equipment needed to conduct over-the-shore operations.

Subobjective 1.1 (Deployment Test). Evaluate the deployment of selected JLOTS equipment on a LASH ship.

Subobjective 1.2 (Deployment Test). Evaluate the deployment of selected JLOTS equipment on a SEABEE ship.

Subobjective 1.3 (Not tested). Evaluate the deployment of the Offshore Bulk System (OBFS) on a breakbulk ship.

Objective 2

Assess the installation and preparation of over-the-shore systems and equipment for cargo operations.

Subobjective 2.1 (RO/RO Test). Evaluate the installation of the Navy calm water RO/RO ship offloading facility on ships with integral ramps.

Subobjective 2.2 (RO/RO Test). Evaluate the installation of the Navy calm water RO/RO ship offloading facility on ships without integral ramps.

Subobjective 2.3. Evaluate the preparation of the Navy Auxiliary Crane Ship (T-ACS) for containership offloading operations.

Subobjective 2.4. Evaluate the installation of the Navy Elevated Causeway (ELCAS).

Subobjective 2.5. Evaluate the installation of the Navy Amphibious Assault Fuel Supply Facility (AAFSF).

Subobjective 2.6 (The ATTF was not available for testing). Evaluate the installation of the Navy Amphibious Tanker Terminal Facility (ATTF).

Subobjective 2.7. Evaluate the preparation of the Army Temporary Container Discharge Facility (TCDF).

Subobjective 2.8. Evaluate the installation of the Army A-Delong Pier Facility.

Subobjective 2.9. Evaluate the installation of the Army Tactical Marine Petroleum Terminal (TMPT).

Subobjective 2.10. (The DASPS was not available for testing) Evaluate the installation of the Army Standard Port System (DASPS).

Subobjective 2.11. Evaluate the installation of the USMC Amphibious Assault Fuel System (AAFS).

Subobjective 2.12. Evaluate the preparation of beach and marshalling areas for over-the-shore cargo operations.

Objective 3

Assess the over-the-shore systems and equipment capabilities for sustained container, breakbulk, vehicle, and bulk POL systems operations.

Subobjective 3.1 (RO/RO Test). Evaluate the capability of the RO/RO offloading facility to discharge vehicle cargo from RO/RO ships with integral ramps in calm water operations

Subobjective 3.2 (RO/RO Test). Evaluate the capability of the RO/RO offloading facility to discharge vehicle cargo from RO/RO ships without integral ramps in calm water operations.

Subobjective 3.3. Evaluate the capability of the T-ACS to offload containerships in Sea States 0-3.

Subobjective 3.4. Evaluate the ALS capability to conduct sustained breakbulk and container cargo throughput operations.

Subobjective 3.5. Evaluate the Army LOTS capability to conduct sustained breakbulk and container cargo throughput operations.

Subobjective 3.6. Evaluate the USMC FLS capability to support sustained breakbulk and container cargo throughput operations.

Subobjective 3.7. Evaluate the joint capability of Services' systems and equipment to conduct sustained breakbulk and container cargo throughput operations.

Subobjective 3.8 (not tested). Evaluate the capability of the Services' to discharge cargo from LASH barges.

Subobjective 3.9. Evaluate the capability to discharge cargo from SEASHEDS on board the T-ACS ship.

Subobjective 3.10. Evaluate the capability of Navy/USMC systems to transfer bulk POL products from offshore commercial tanker vessels to shore storage facilities.

Subobjective 3.11. Evaluate the capability of the Army systems to transfer bulk POL products from offshore commercial tanker vessels to shore storage facilities

Objective 4

Assess the capabilities of the Services' to manage and control the movement of container and breakbulk cargo in sustained throughput operations over-the-shore.

Subobjective 4.1. (DASPS was not available) Evaluate the Army DASPS in sustained cargo throughput operations over-the-shore.

Subobjective 4.2. Evaluate the USMC cargo documentation and control system in sustained cargo throughput operations over-the-shore.

Objective 5

Assess the capability of the Services' to transition from a Navy ALS/Marine Corps FLS operation to an Army LOTS operation.

Subobjective 5.1. Evaluate the procedures, systems, and equipment requirements necessary to support the transition from Navy to Army over-the-shore operations.

Subobjective 5.2. Evaluate the joint operation of systems and equipment during the transition from Navy to Army over-the-shore operations.

2.0 TEST DESCRIPTION

The Throughput Test commenced where the Deployment Test ended. The ALS, FLS, and LOTS equipment, assumed to have been discharged from commercial ships, were administratively delivered to the test site and the test began with installation and preparation for cargo throughput operations.

2.1 TEST AREA

Test site selection involved both administrative and operational criteria. Administrative criteria considered factors such as movement costs of participating units to the test site, test and evaluation characteristics (too benign, to restrictive, etc.), potential environmental conditions, and capabilities to provide general support for about 3000 personnel. Operational criteria considered factors such as anchorages, beach approaches, in-shore and hinterland characteristics, plus site preparation and equipment limitations. Military shore locations were considered the best potential test sites due to the relative ease of gaining access and the requirement for associated open operating spaces. Military establishments located along the shores of the continental United States and Puerto Rico were surveyed to determine which location had the highest probability for obtaining the desired Sea State 3 conditions, a criteria considered to be a high priority.

Fort Story, Virginia was selected as the site for the Throughput Tests. It was convenient because of its proximity to the Norfolk terminals where containers, other cargo, and test equipment may be loaded aboard the participating vessels. It was appropriate for the Throughput Test because of the probability of Sea State 3 in the September/October time frame, adequate water depth, and sufficient beach area to support the activities of joint military operations. Also, the proximity to Fort Eustis and Little Creek minimized the cost of transporting equipment to the test site. This proximity also ensured the availability of a haven for maintenance, emergencies, or other contingencies. These factors, however, limited the scope of the evaluation in that performance of deployed support functions could not be assessed.

Figure 2-1 shows the Fort Story test site during the Throughput Test.

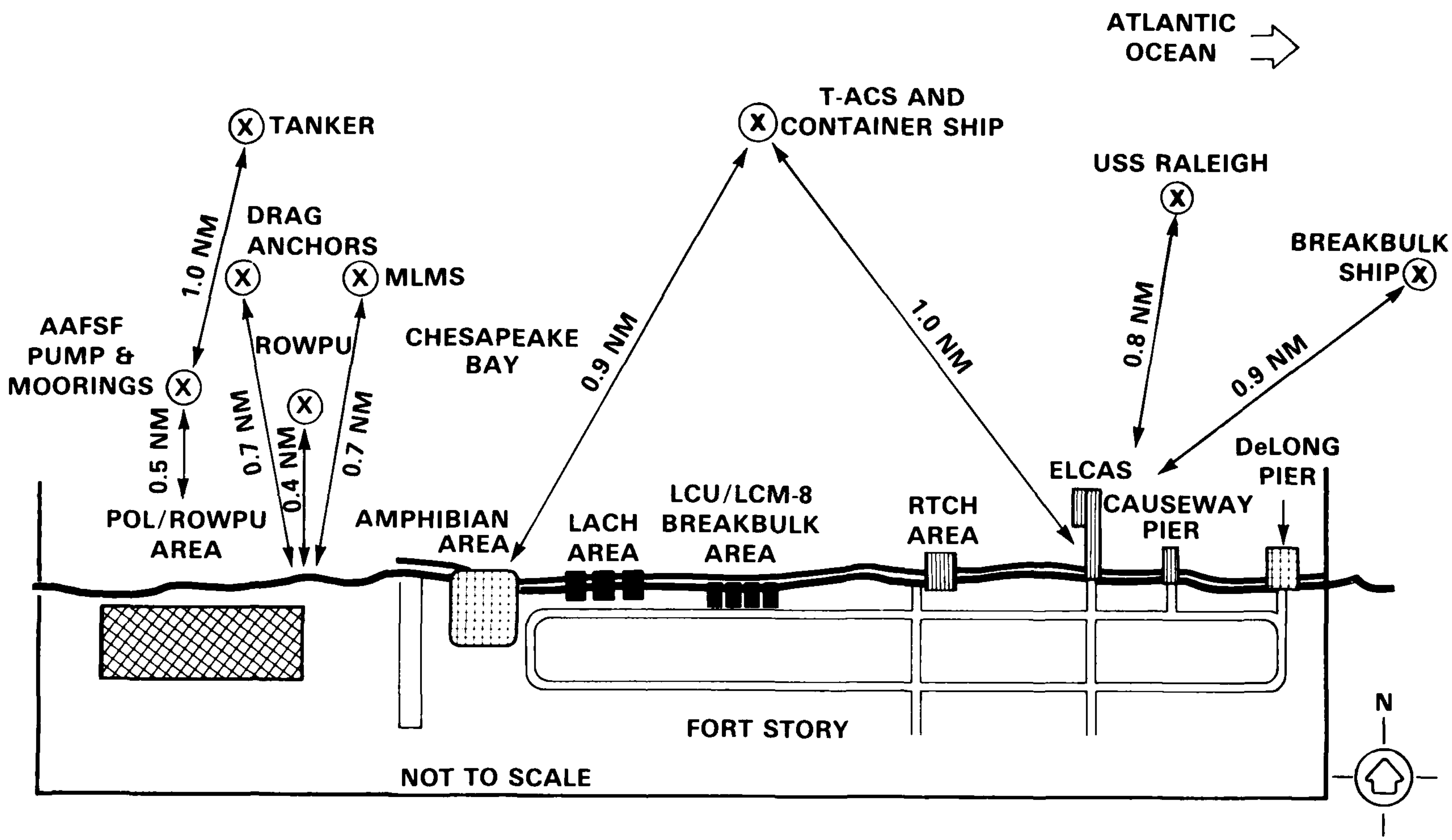


Figure 2-1 - Fort Story, Virginia Throughput Test Site

The test area included the Fort Story RED and BLUE beaches. These beaches are west of Cape Henry, and face Chesapeake Bay. There is a northeasterly exposure to Cape Charles (across Chesapeake Bay) and the Atlantic Ocean. The JLOTS I tests in 1976/1977 were conducted at the same site.

A beach survey was conducted prior to the start of the Throughput Test. The survey determined that several sandbars were present in all of the designated beaching lanes. The sandbars were so numerous and large that it was recognized that lighterage operations during low tidal periods would be slowed and in some cases delayed. No attempts were made to remove the sandbar because of environmental concerns.

2.2 TEST ORGANIZATION

The Joint Test Director (JTD) was responsible for the overall planning and execution of the test. The Joint Test Directorate was located at the Naval Amphibious Base, Norfolk, Virginia until just prior to the start of the Throughput Test, at which time the Directorate moved to Fort Story. The organization of the Joint Test Directorate is shown in Figure 2-2. The Joint Test Director directed a test that permitted operational commanders to receive overall mission statements for the test and as such, employ their normal military chain-of-command to execute the test.

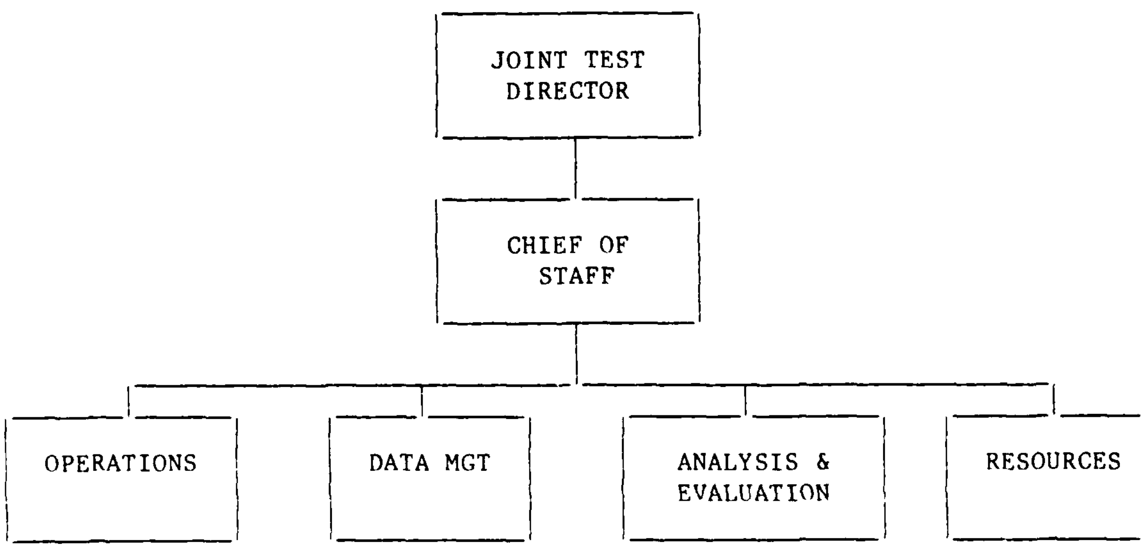


Figure 2-2 - JLOTS II Test Directorate Organization

2.2.1 Joint Test Force

During the Throughput Test, t:. Joint Test Director ·ted as the Unified Commander for units/forces ass_ .OTS] est. This role facilitated appropriate direction in order to accomplish test objectives. This arrangement also reflected a typical command structure that may exist in a given scenario or actual joint operation. Reference 6 provides additional information concerning organization, operation, and JLOTS II lessons learned dealing with the Joint Test Directorate.

2.2.2 Service Commands

During the Throughput Phase of JLOTS II, there were three separate segments of the test in regard to overall Command and Control procedures.

2.2.2.1 U.S. Navy/U.S. Marine Corps Period

The Service Senior Commander, Commander Amphibious Task Forces (CATF) was responsible for directing all Navy/Marine Corps units involved in the test. This period of the test addressed an amphibious operation which combines elements of the Navy ALS and the USMC FLS.

The CATF during the Navy/Marine Corps portion of JLOTS II was Commander, Amphibious Squadron Four (CPR-4), embarked in USS RALEIGH (LPD-1). There were two phases of command and control during this portion of the test.

The first phase was that period commencing when COMPHIBRON FOUR, as CATF, arrived in the area of Fort Story, Virginia, and established an Amphibious Objective Area (AOA). The second phase of the Navy/Marine Corps portion was in effect during the transition period and ended when the Army assumed Operational Control (OPCON) of the test.

2.2.2.1.1 Amphibious Objective Area (AOA) Established

In accordance with amphibious doctrine, CATF was in overall command of the Amphibious Task Force (ATF), with Commander Landing Force (CLF), the Naval Beach Group, and the Navy Cargo Handling and Port Group under his Operational Control (Figure 2-3).

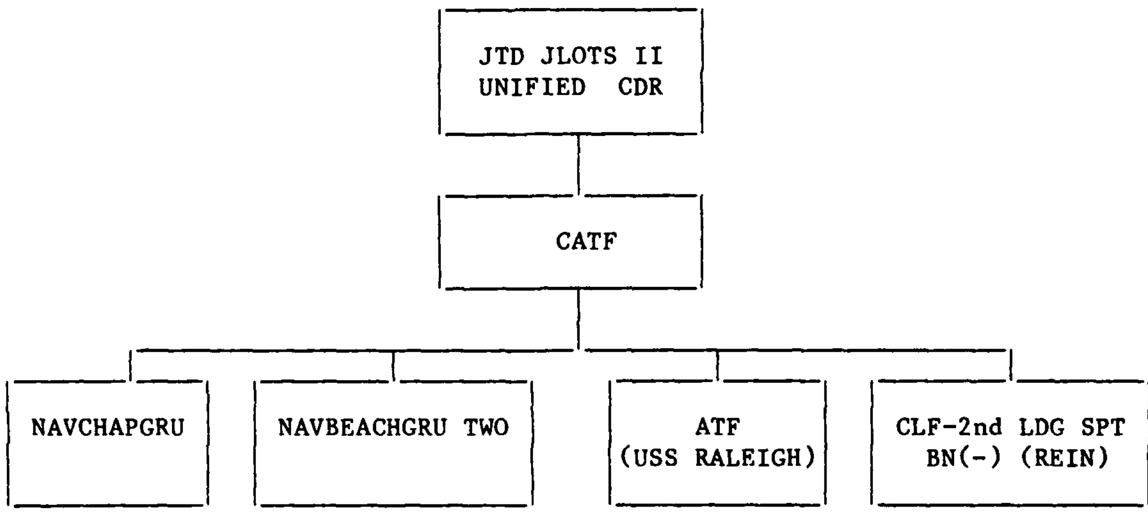


Figure 2-3 - Naval Organization, Amphibious Objective Area Established

2.2.2.1.2 Amphibious Objective Area (AOA) Disestablished

It is assumed that the AOA had been disestablished, CATF had become Commander, U.S. Forces, Country and CLF had become Commander, U.S. Marine Forces, Country. The Army Commander had become Commander, U.S. Army Forces, Country as illustrated Figure 2-4.

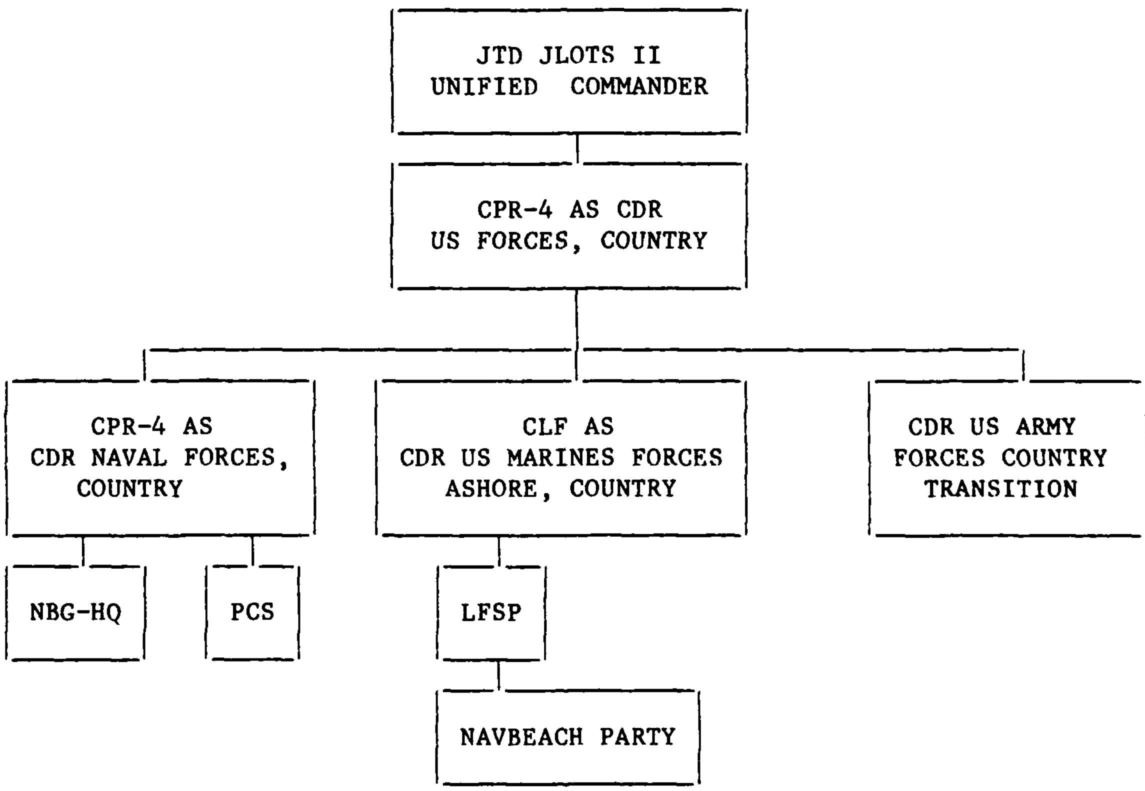


Figure 2-4 - Naval Organization, Amphibious Objective Area Disestablished

2.2.2.2 Army Period

The Army assumed full responsibility for test operation about mid-way through the overall test period. At that time, the Navy systems were withdrawn. The Army then accomplished all test operations with assigned Army units/equipment.

2.2.2.2.1 U.S. Army Command and Control

The Service Senior Commander during the Army portion of JLOTS II was the Commander, 7th Transportation Group. During test operations, the 7th Transportation Group established a Forward Command Post (FWDCP) at Fort Story, Virginia. From this CP, the 7th Group Commander exercised overall command and control of Army Forces involved in the test. The organizational structure is illustrated in Figure 2-5.

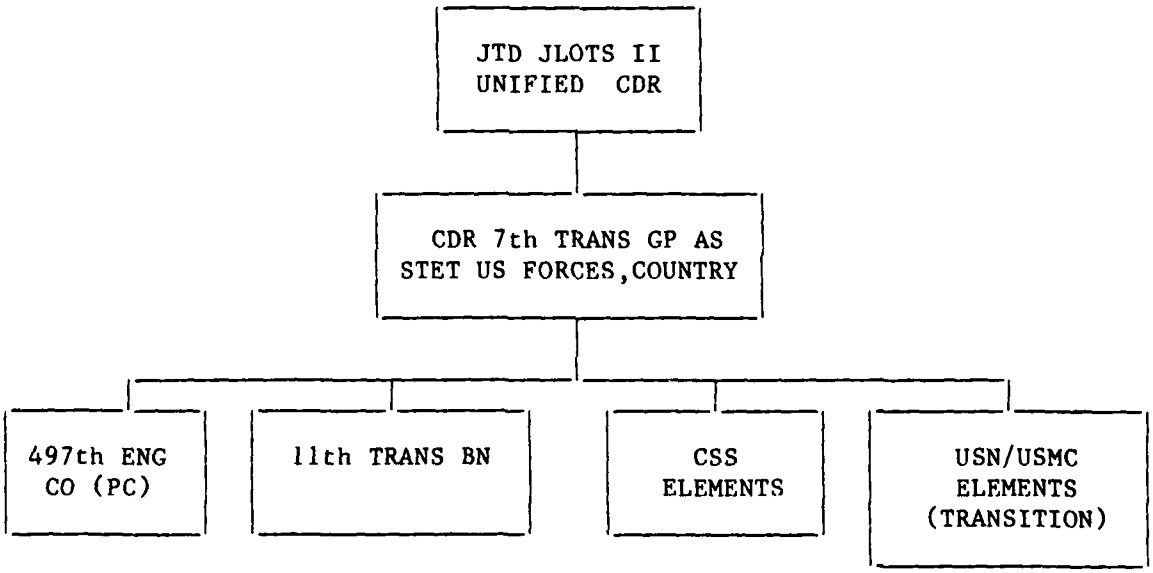


Figure 2-5 - Army Organization

2.2.2.2.2 Major Operating Command

The 11th Transportation Battalion (Terminal Service) exercised operational command/control over all company and detachment sized units committed to the dry cargo portion of the test.

2.2.2.2.3 Other Combat Service Support (CSS) and Administration Functions

All Army units/activities committed in support of JLOTS, but not directly involved in test operations, were coordinated by the 7th Transportation Group, Forward CP at Fort Story.

2.3 TEST SYSTEMS

Military equipment, organizations, and commercial ships, all combined, comprised the various systems tested during JLOTS II. These systems are a part of our nation's Strategic Sealift Program to provide afloat prepositioning and ocean movement of materials, petroleum, oil and lubricants (POL), and personnel in support of assigned logistic support missions of the U.S. Government, including cargo handling systems and personnel to ensure delivery of cargo ashore. The ships and cargo offload and discharge systems tested during the Throughput Test are described within the following subsections.

2.3.1 Commercial Ships

Four civilian-crewed ships were obtained for the Throughput Test. Commercial chartering procedures were required to obtain a containership, breakbulk ship, and tanker through the Military Sealift Command (MSC). The containership, breakbulk ship, and Auxiliary Crane Ship were maintained by the Maritime Administration (MARAD) in the National Defense Reserve Fleet.

2.3.1.1 Containership

The containership requested for the Throughput Test was originally to be a fully crewed and operational nonself-sustaining (NSS) containership that could carry up to 1000 twenty-ft containers and 20 forty-ft containers. However, a partially crewed, unactivated ship from the Ready Reserve Fleet (RRF) was selected.

The NSS containership used for JLOTS II was the SS EXPORT LEADER (Maritime Administration designation, C5-S-73b), a 17,900 DWT vessel, 610 ft in length overall with a maximum draft of 31.5 ft, and a total cargo capacity of 1070 TEU (twenty-ft equivalent units). Twenty-ft containers were stowed in forty-ft cells. The ship was crewed by approximately 12 merchant mariners hired by a commercial operating company. Figure 2-6 shows the SS EXPORT LEADER moored on the starboard side of the Auxiliary Crane Ship.

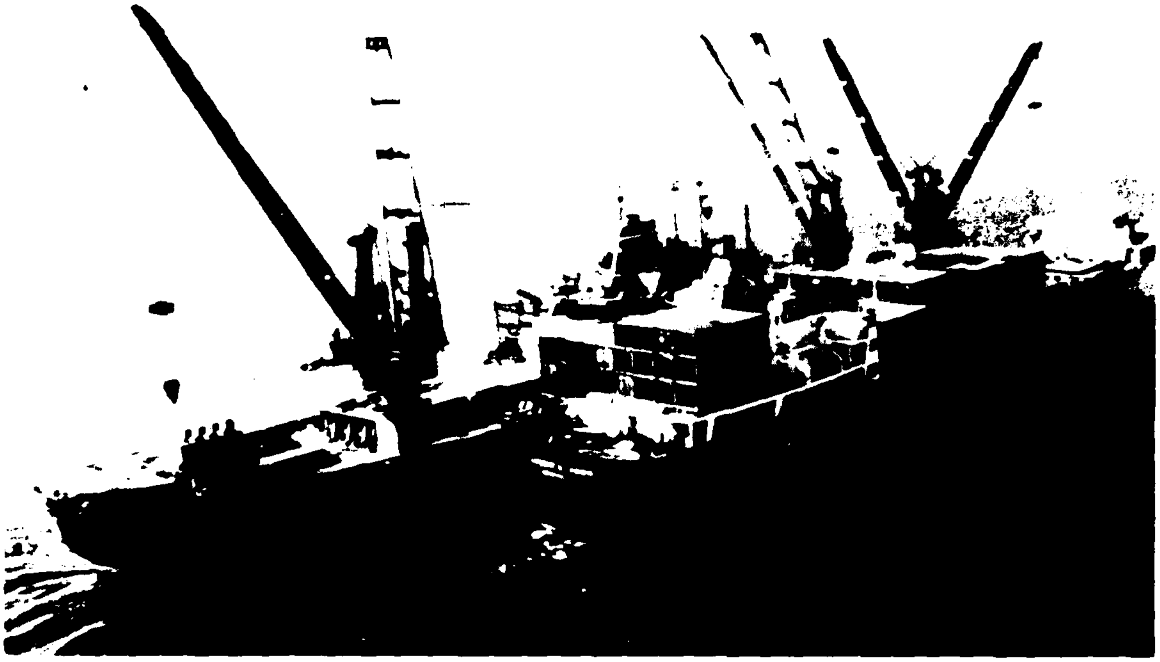


Figure 2-6 - SS EXPORT LEADER

The ship's propulsion plant was not activated and therefore, the ship was moved to the test site by commercial tugs. Twenty-ft MILVANS were selectively loaded above the hatch covers on the port side to provide clearance for the T-ACS cranes with their rider block sheave extensions. The MILVANS were only stacked one-tier high at those areas and three-high in other locations.

2.3.1.2 Breakbulk Ship

The breakbulk ship requested for the Throughput Test was to be fully crewed and operational. It was determined by the staffs of the Chief of Naval Operations (CNO) and MSC that the charter request could best be served through the activation of an asset from the RRF.

The breakbulk ship used for JLOTS II was the SS CAPE ANN (C4-S-58a), an 11,300 DWT vessel, 572 ft in length overall, with a maximum draft of 30.5 ft and a total dry cargo capacity of 628,814 cu ft. The seven-hatch ship, with three single booms and three twin booms for cargo handling, was fully activated from the RRF. Figure 2-7 is the SS CAPE ANN.

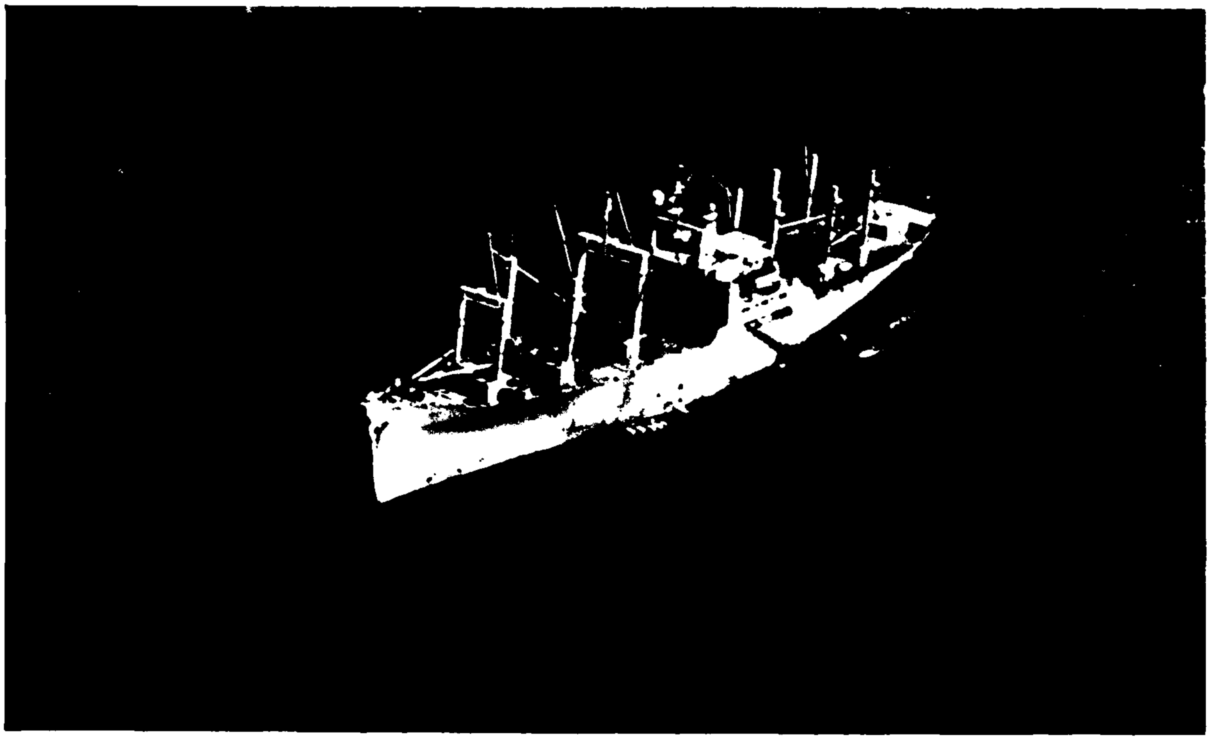


Figure 2-7 - SS CAPE ANN

2.3.1.3 Tanker

The tanker requested for JLOTS II was to be a fully operational tanker with a capacity to transport three million gallons (11,156 LT) of fresh water. A detailed tanker cleaning protocol in the charter included:

- chemical cleaning of tanks, pumps, valves, and piping;
- tanks physically inspected prior to water loadout;
- water required to be free of hydrocarbon residue; and
- water tested shoreside, after filling tanks and again when ship arrived on station.

The tanker used for JLOTS II was the MV SEADRIFT, a 16,576 DWT vessel employed commercially as a bulk chemical carrier, 503 ft in length overall, with a maximum draft of 31 ft. The ship had a total cargo capacity of 15,600 LT with a capability to carry two grades of product. In addition, this vessel was equipped with a bow thruster, and triple screwed at the stern, with 360-deg directional control on outboard screws. Fresh water for the test was obtained from the James River. Figure 2-8 is the MV SEADRIFT.

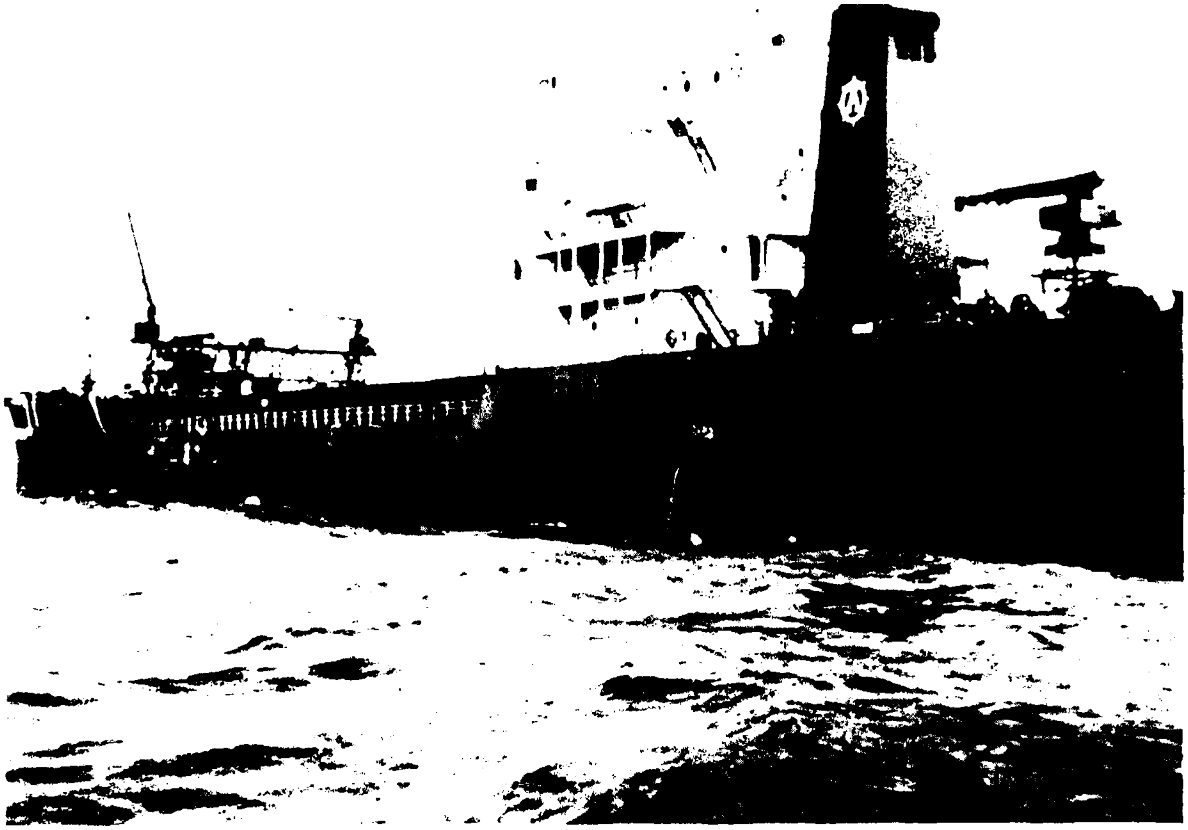


Figure 2-8 - MV SEADRIFT

2.3.1.4 Auxiliary Crane Ship (T-ACS)

The T-ACS is a complete, self-deployable, container/oversize cargo discharge system. It can be deployed to advanced operating areas to support cargo discharge operations for all services in overseas theaters. It has the following multi-mission capabilities.

- Offload other nonself-sustaining (NSS) containerships, particularly other containerships to PANAMAX size, that are moored alongside. Their cargo could be 20- or 40-ft containers, general breakbulk cargo, and large military cargo, including 65-STon tanks.

- To carry a load of general cargo,including 65-STon tanks and other military vehicles, containers, and lighters which weigh 95 STons or less such as causeway sections and LCM-8's to a forward deployment area at 20 knots.

- Load and unload the above cargos with the ship's own cranes, either at a pier or at anchorage onto lighterage carried onboard or provided in the operational area.

Each crane ship system is designed to meet or exceed the following sustained throughput, given the expected distribution of standard cargo weight and size, day and night average over a 20-hr working day:

Sea State*	Lifts Per Vessel
0	300
1	300
2	280
3	260**

*Pierson-Moskowitz Sea State

**Productivity average shall be with head and beam seas and with use of active vertical motion compensation which was not available for evaluation during the Throughput Test.

The ship's crew is civilian maritime labor and includes able-bodied seamen who were trained and used as crane operators. The cargo handling crew normally consists of tagline handlers, hatch captains, signalmen, and equipment repairmen.

The T-ACS provides fenders, mooring lines, and line handling equipment for containerships coming alongside. The T-ACS will act as control ship or, the anchored ship, during mooring operations. The T-ACS provides, maintains, and installs the large fenders needed to separate the ships at open-water anchorages. The SS KEYSTONE STATE (T-ACS 1) was chartered through MSC for the Throughput Test and was the primary system for offloading containers from the nonself-sustaining containership. Figure 2-9 is T-ACS-1 (SS KEYSTONE STATE) with a containership moored alongside.

The KEYSTONE STATE, T-ACS-1 (ex-PRESIDENT HARRISON, C6-S-1qc) is one of three in a class originally laid down as MARINER Class vessels, and completed as such in October 1965. KEYSTONE STATE was subsequently modified in 1972 by the addition of a 105-ft midbody and conversion of breakbulk holds to container holds into the present C6 ship. This vessel has seven holds, a raised forecastle, and has bridge and superstructure aft of midships. The principal characteristics after modification to T-ACS-1.

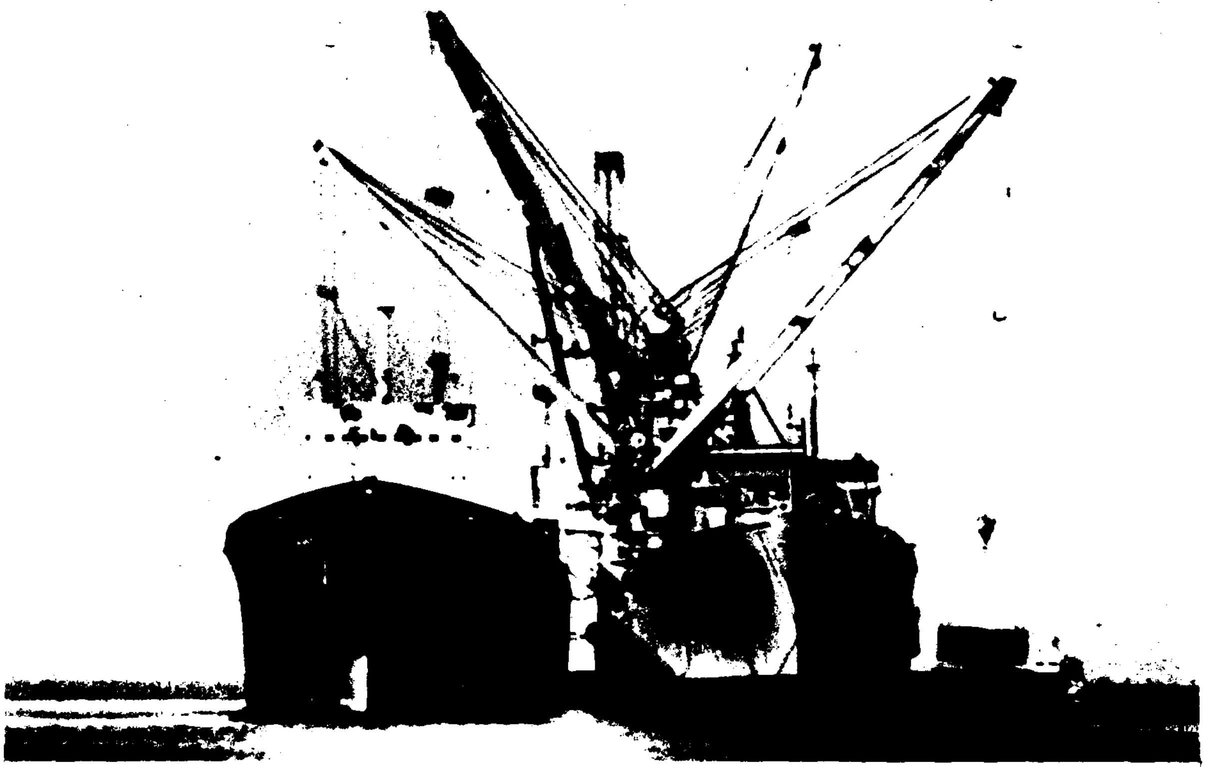


Figure 2-9 - SS KEYSTONE STATE (T-ACS-1)

Principal Characteristics after Modification to T-ACS-1

Length	668-ft 7-3/4 in.
Beam	76-ft 0-in.
Depth	44-ft 6-in.
Draft, Optimum for Cargo Operations	25-ft 0-in.
Draft, Full Load	31-ft 0-in.
Total Deadweight at Full Load Draft	13,600 LT
Total Displacement at Full Load Draft	28,660 LT
Fuel Oil Tankage (Bunker C)	3,126 LT
Diesel Oil Tankage	201 LT
Fresh Water Tankage	245 LT
Type of Machinery	Steam, Turbine
Generator for Cranes	2 Diesel, 1640 kw each
Propeller(s)	1
Sustained Sea Speed	20 knots
Endurance at Full Load Draft and Maximum Continuous Horsepower	13,000 NM

T-ACS-1 was equipped with three independent twin boom pedestal cranes, all mounted on the starboard side. Two are located forward of the superstructure and one aft of the superstructure. Each crane is capable of lifting 33 STons on each boom at an effective outreach from the starboard-side of the ship of 108 ft; 65 STons with paired booms at an effective outreach of 75 ft from the starboard side; and 95 STons with paired booms and Cranes 1 and 2 teamed at an effective outreach of 27 ft from the port side of the ship.

All six booms have a pendulation control device in the form of a Rider Block Tagline System, and a load orientation control device which is a powered rotator. The Rider Block Tagline System consists of two winch systems. The rider block winch takes up or pays out wire rope for vertical positioning of the rider block which "rides" on the cranes main hoist wire rope falls. The tagline winch takes up or pays out two wire ropes for horizontal positioning of the rider block to prevent excessive load swing or load pendulation. Since both of the winch systems utilize the same electric controller, it is not possible to operate both winches simultaneously and there exists a 5 to 6 sec time delay to change from one mode to the other. Even though this time delay feature existed, the Rider Block Tagline System was expected to control load position of cargo during sea conditions up to Sea State 3[7]. Figure 2-10 shows the Rider Block Tagline System. Each boom is also equipped with a self-leveling spreader bar capable of operator controlled latch and unlatch of either 20-or 40-ft containers. The spreader bars can be removed and an equalizing beam attached to enable paired boom lifts of loads up to 65 STons.

Each crane was equipped with a remote control console which permits control to be transferred from the crane cab to a remote operator near the port-side lighterage mooring stations. The remote console controls hoist, luff/slew, rider block hoist and tag lines, hook rotation, and bayonet lock/unlock. Each remote console had a 50-ft length of electrical cable to permit operator mobility. Unfortunately, the remote control console was not tested during JLOTS II. The crane operators preferred their normal cab location and, since they had a reasonably good view of the lighters, they did not use the remote device. It should also be noted that the short

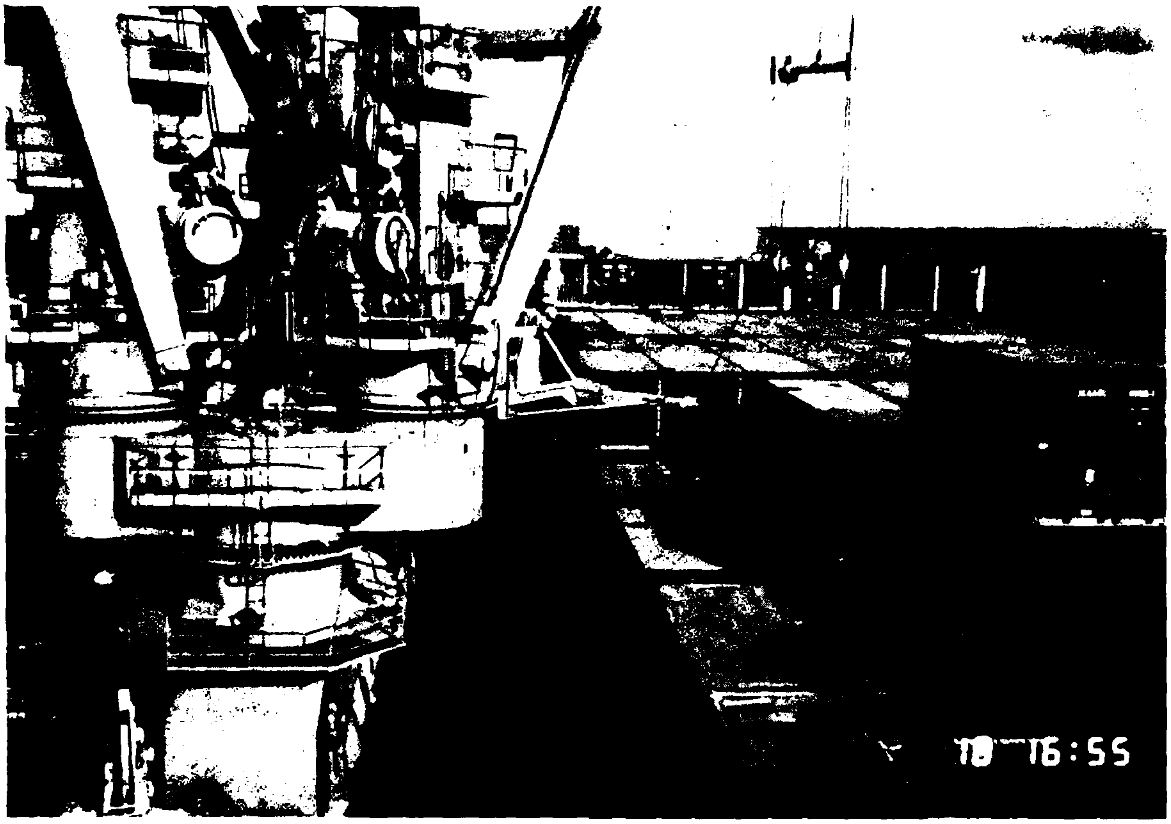


Figure 2-10 - Rider Block Tagline System on SS KEYSTONE STATE

50-ft cable prevented the use of the remote console on the SS EXPORT LEADER and even if the cable was longer, the logistics of the remote operator moving between ships (container cell hatch opening area to T-ACS mooring station) was not practical.

2.3.1.4.1 Ground Tackle

Since the T-ACS was the ship at anchor for the nest with the containership, the ship's original bower anchor system was modified. A balanced, 2 fluke anchor weighting 13,200 lb was installed as the port anchor. This anchor, shown in Figure 2-11, is a balanced fluke anchor with a high holding power of 9:1 as compared to 7:1 for the stockless anchor originally outfitted on the KEYSTONE STATE. The anchor should provide 100,000 lb or more holding power which is sufficient to hold the T-ACS-1 and a PANAMAX-size ship safely in winds up to 30 knots and currents of 1.5 knots or less.

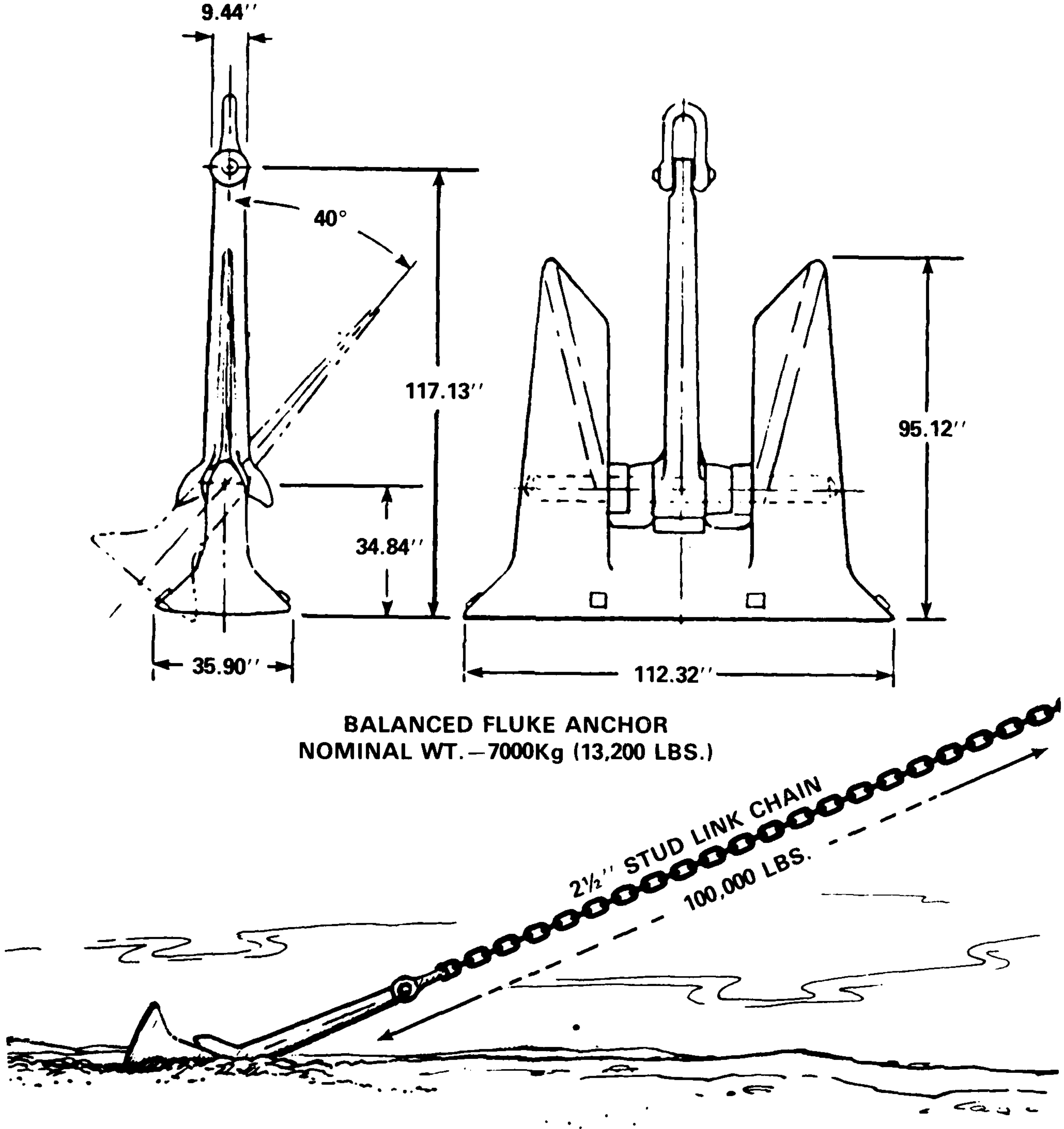


Figure 2-11 - T-ACS Anchoring System

The ground tackle on T-ACS-1 was as follows:

Anchors:	1 - 13,200 lb balanced, 2 fluke (Port)
	2 - 13,200 lb stockless (Stbd) & spare
Anchor Wildcat:	Electro-hydraulic
Anchor Chain:	360 fathoms, (180 fathoms to each anchor) 2-7/16 in. grade 3 steel, stud link with swivels and shackles

2.3.1.4.2 Fenders for Containerships

To accommodate a variety of large containerships, T-ACS-1 had a number of large fenders to protect the two ships while at anchor . open seaways. The primary fenders consist of the following:

- Two Dunlop low pressure pneumatic - 14.5-ft x 52-ft.
- Two Seaward foam filled with tire and chain net - 10-ft x 16-ft.
- Three Yokohoma high pressure pneumatic with tire and chain net 10-ft x 20-ft.

These large fenders are intended to provide more than adequate energy absorption capability, but the size is required to provide separation between the moored ships. Rolling and load-induced heeling are sources of motion that affect the separation requirement.

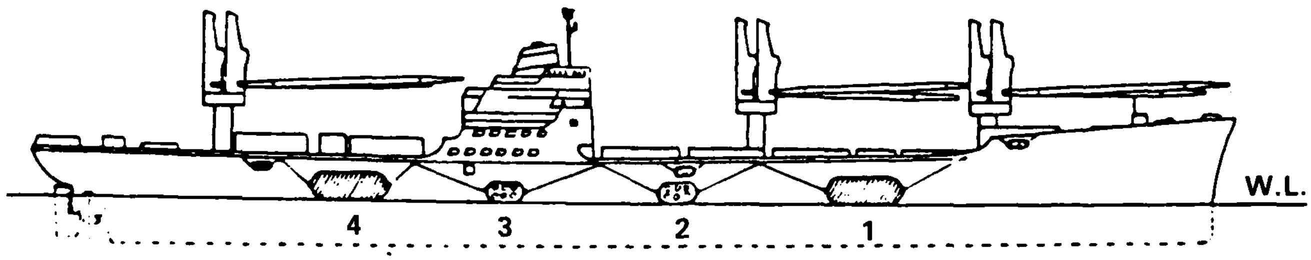
There are four secondary fenders, any three of which will normally be secured to the main deck and forecastle fixtures to provide backup to the primary fenders during mooring and unmooring, and in the event of severe rolling. These are Rubber Miller 6-ft x 12-ft foam-filled fenders.

Figure 2-12 shows the fender arrangements for 10- and 14-ft stand-offs between the T-ACS and various containerships.

The fender arrangement for a 10-ft stand-off was the only system tested during JLOTS II. These fenders were stowed in Hold Nos. 1 and 7 prior to their installation.

14 FT. STANDOFF

L.P. PNEUMATIC
10 FT. BACKUP
FOAM
6 FT. SECONDARY



10 FT. STANDOFF

FOAM AND PNEUMATIC
6 FT. SECONDARY
FOAM

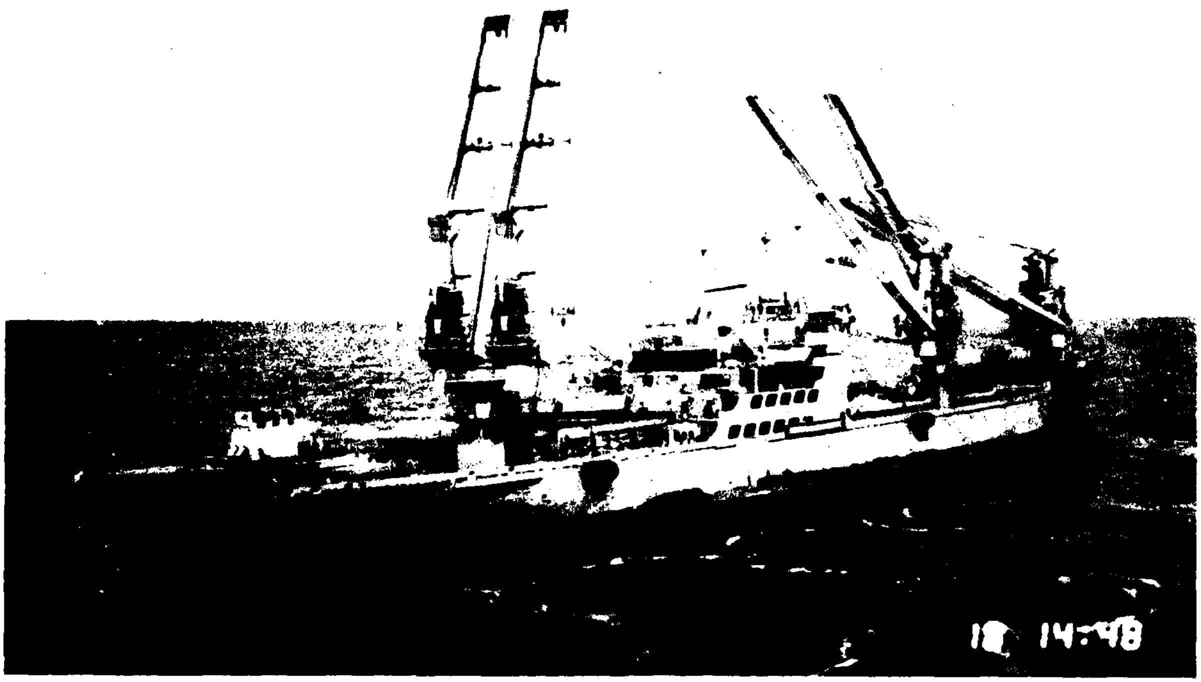


Figure 2-12 - T-ACS Fenders for Containerships

2.3.1.4.3 Lighterage Fenders, Tending Lines, and Mooring Stations

The T-ACS carries a fender system for lighters consisting of H-fenders suspended from the port bulwark railing. The fenders are wooden timbers set into steel frames which provide 18 in. stand-off between the ship and lighters. The fenders (shown in Figure 2-13) hang about 3 ft in the water, and are spaced about 25-ft apart.

Lighters can secure to 8-ft pendants pre-rigged on Panama bitts to hold the craft alongside. These Panama bitts are about 25-ft apart just above the waterline along the ship's port side, as shown in Figure 2-13. Additional spring or headlines can be passed from T-ACS to the craft alongside as needed. These are 4-in. double-braided nylon lines and will be tended by T-ACS crew members.

There are three mooring stations, numbered 2, 4, and 6, on the port side of the ship for handling various lighters, two forward and one aft, as shown in Figure 2-13. When loading only landing craft, all three stations may be used. When there is a long Causeway Ferry alongside, it will normally occupy both Stations 2 and 4.

2.3.1.4.4 SEASHEDS

SEASHEDS provide containerships and container capable ship such as the T-ACS with the capability to transport outsized and other cargo such as trucks, tanks, and palletized cargo. A SEASHED is a large open top container which is positioned by a shoreside container crane into the ship's container holds in place of three side-by-side containers. Minor modifications to the T-ACS cargo holds were required to accommodate the SEASHEDS. The principal modifications included strengthening of the center cell guides and the tank top in the bottom of Cargo Hold 4B. Three SEASHEDS were installed for the Throughput Test. The SEASHEDS were used for stowage of the 20-ft modular causeway units, fenders, and other miscellaneous hardware. Figure 2-14 gives an illustration along with some of the principal data. Since the SEASHED is 50% higher than a standard ISO container, four can be stacked in the vertical space normally holding six containers. The SEASHED floor has a large hatch which can be opened electrically for cargo work-through, as shown in Figure 2-15.

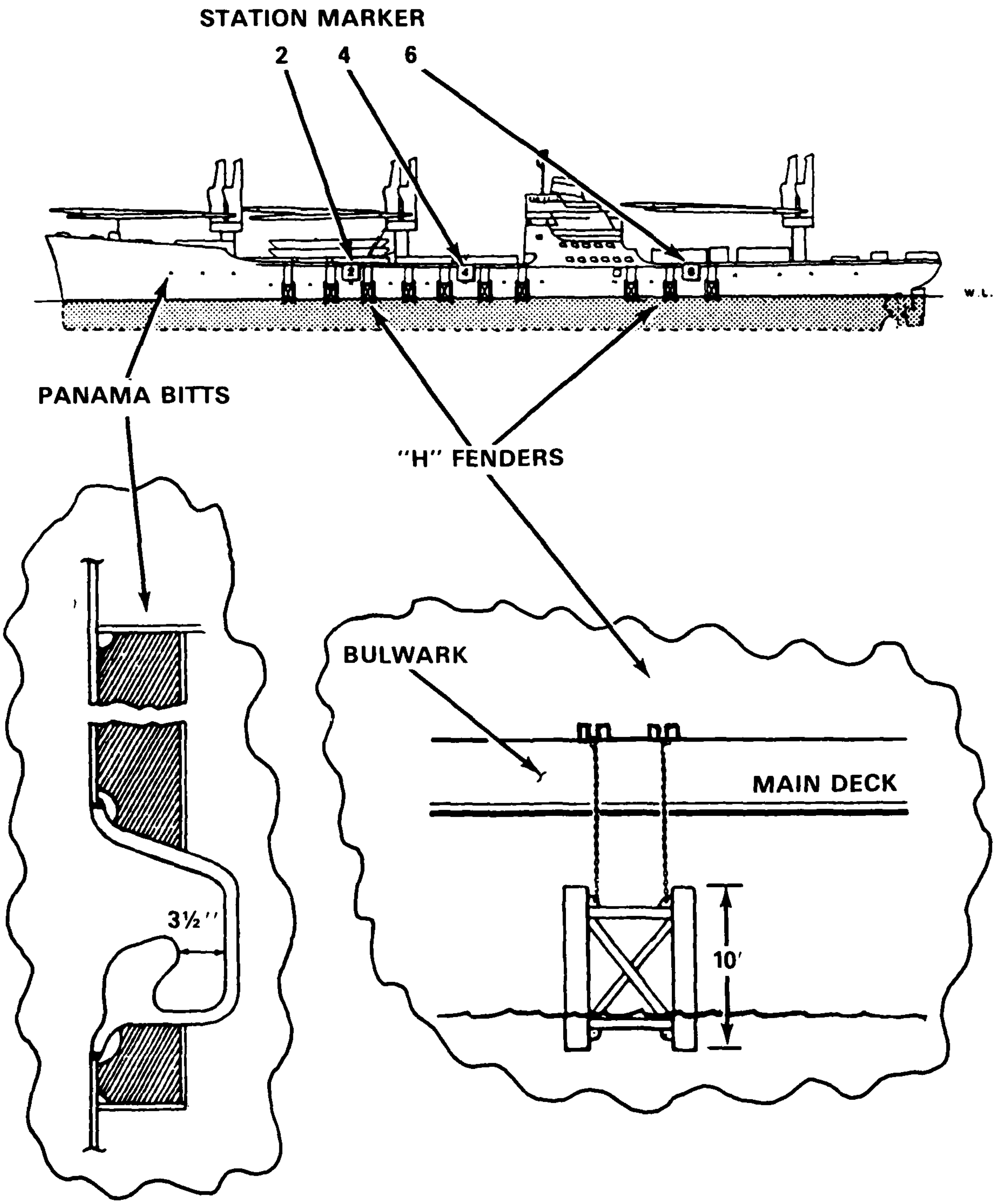


Figure 2-13 - T-ACS Lighterage H-Fenders, Mooring Bitts, and Station Markers

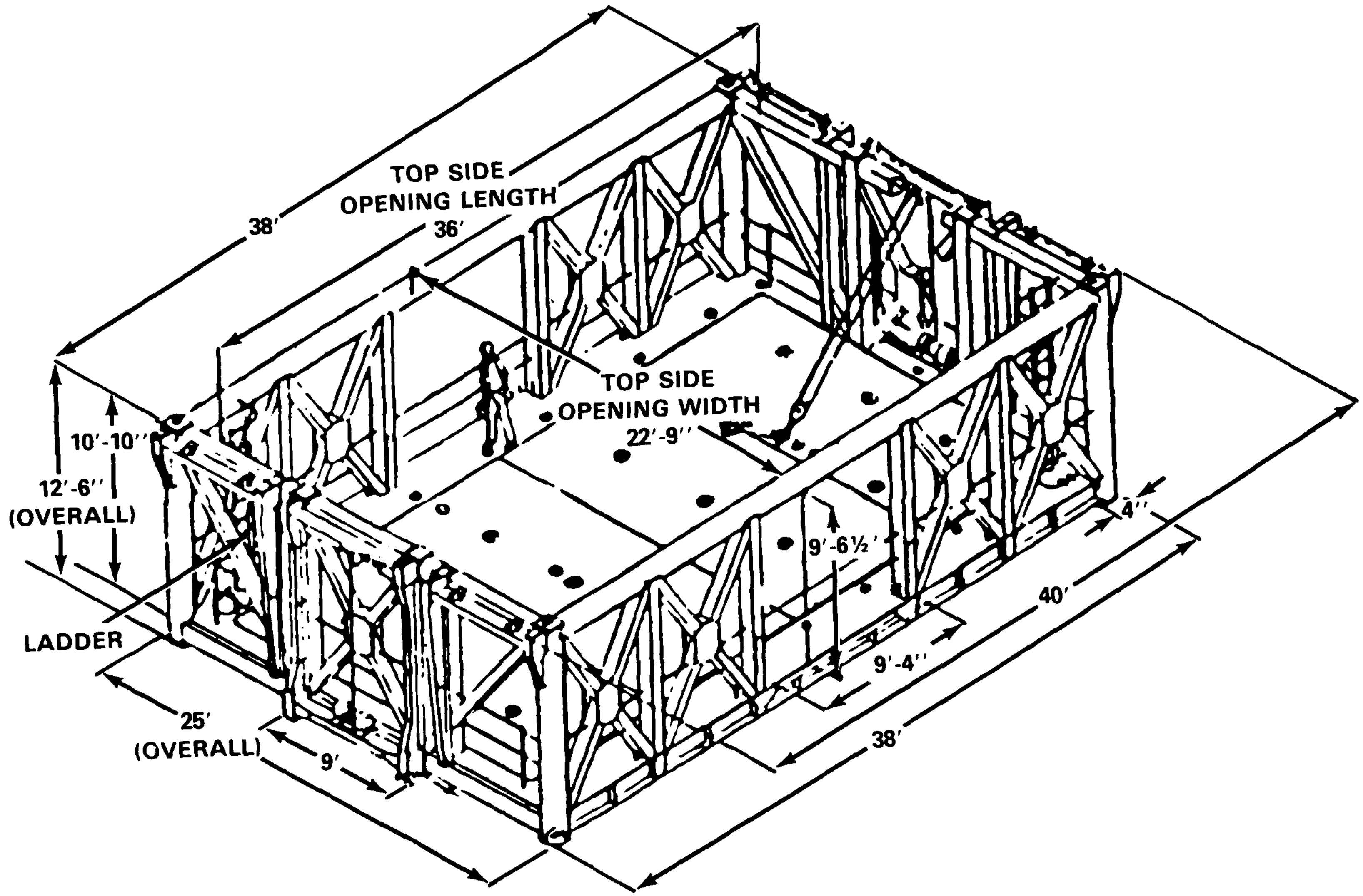


Figure 2-14 - SEASHED General Arrangement

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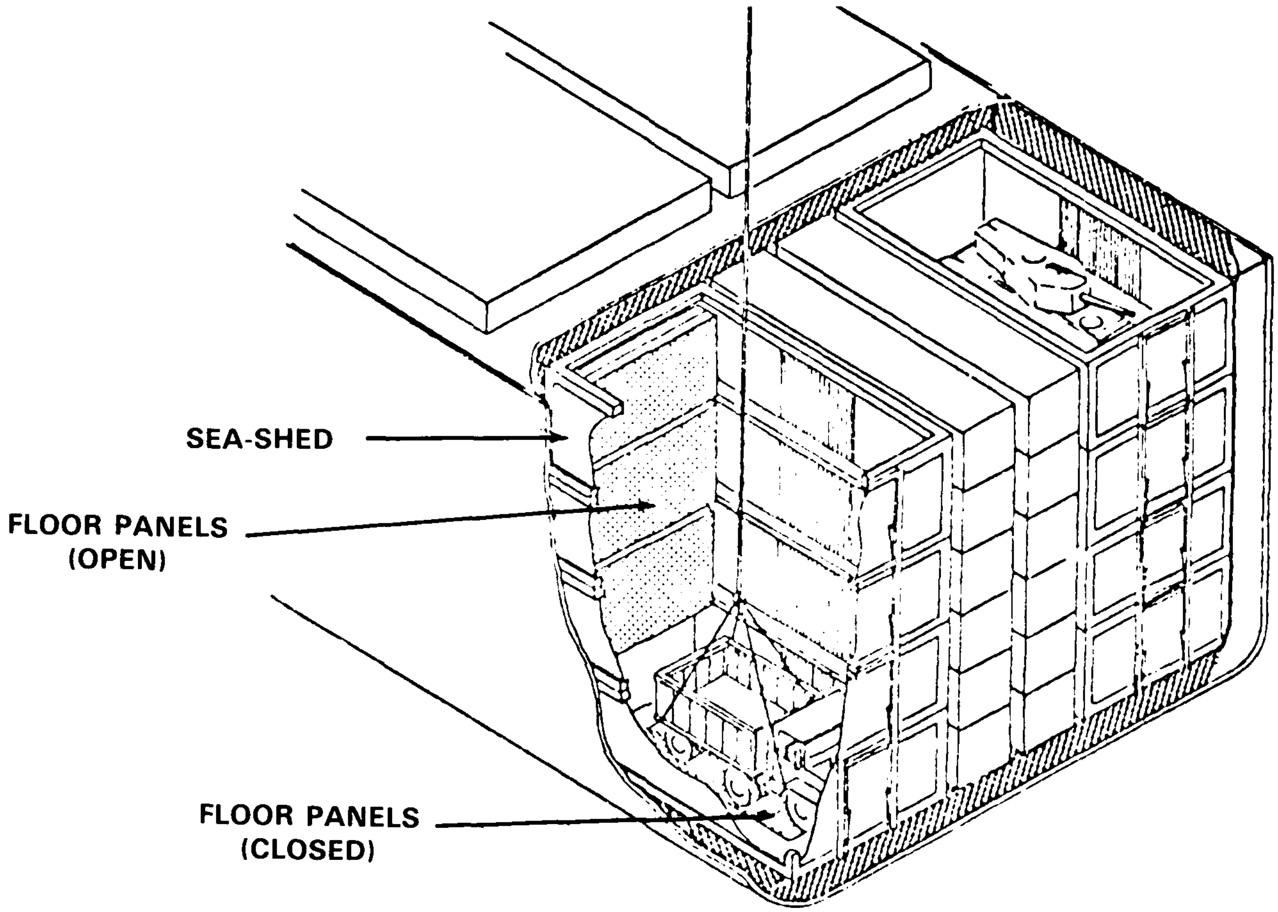


Figure 2-15 - SEASHEDS Work-Through Arrangement

The SEASHED has steel box beams and columns for its main frame. Located on the top corners are stacking cones for securing one SEASHED on top of another.

- Exterior maximum dimensions:

  40-ft long by 25-ft wide by 12-ft 6-in. high
- Inside clear dimensions with work-through floor closed:

  35-ft 10-in. long by 22-ft 9-in. wide by 10-ft 10-in. high
- Clear opening through floor: 30-ft long by 18-ft wide
- SEASHED weight: Approximately 30 LTon
- Rated cargo capacity: 98 LTon
- Eligible cargo for the lower SEASHED should not exceed the following dimensions:

  29-ft 6-in. long by 17-ft 4-in. wide by 10-ft 10-in. high

The floor, with cargo tie-down fittings is built to accommodate a uniform load of 425 psf.

2.3.2 Navy/USMC Ship-to-Shore Discharge

The preceeding section described the commercial ships which carried the dry and liquid cargos to be used in the test. The major systems and

equipment used by the Navy and Marine Corps in transporting this material to the beach and/or Marshalling Yard (containers and breakbulk cargo) are described in the following subsections.

2.3.2.1 Navy Lighterage and Support Craft

The Navy used Causeway Ferries and LCU's to move containers, and LCM-8's and LCU's to move breakbulk cargo. The Causeway Ferries were made up in different lengths in order to evaluate their performance, and each ferry was either powered by a new Causeway Section, Powered (CSP) or by two modified LCM-6 tender boats. The tender boats are being phased out and the new, modern CSP's will replace them. Five unique Causeway Ferry configurations were tested as shown and described in Figure 2-16.

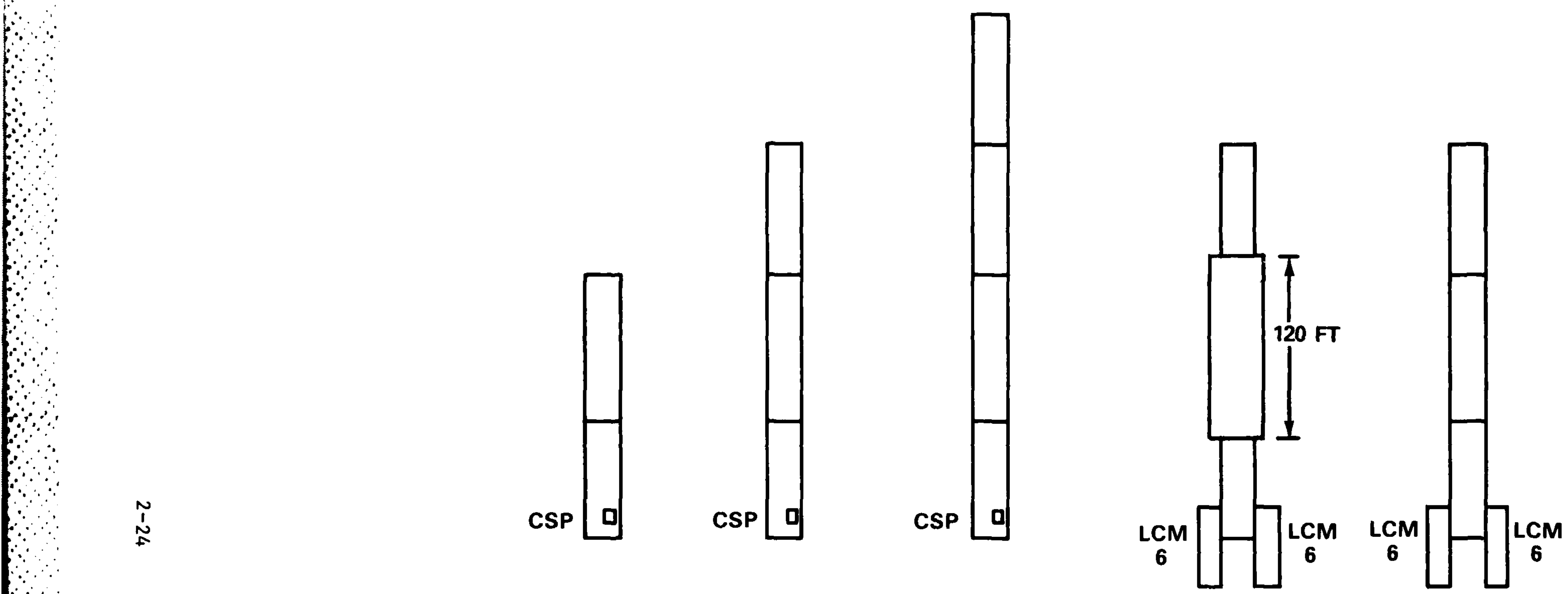
Each CSP, as shown in Figure 2-17, is powered by two Waterjet Propulsion Assemblies (WPA). The CSP's can ferry the loaded causeway sections either directly to the beach or to the pierhead of the ELCAS. When a CSP is fitted with an A-frame at the bow, a deck winch, and other equipment (as shown in Figure 2-18), it becomes a Side-Loadable Warping Tug (SLWT). SLWT's are used extensively in the installation of the ELCAS and the fuel delivery systems, assembling Causeway Ferries and RO/RO Discharge Facilities and salvaging beached craft.

The CSP is a merging of the Waterjet Propulsion Assembly (WPA) and a nonpowered pontoon assembly, with the overall dimensions of approximately 21 ft x 90 ft. Configured as a SLWT, as shown in Figure 2-18, it includes both the WPA and nonpowered pontoon assembly, with the overall dimension of approximately 21 ft x 84 ft for performing warping tug functions.

The characteristics of individual causeway sections tested are listed in Table 2-1.

The CSP/SLWT are designed to meet the following operational requirements:

- Capable of deployment by merchant ship or side-carried on LST's in either the CSP or SLWT configuration.
- Capable of withstanding exposure of extended LST side-carry impacts of controlled side launching.
- Capable of operating in seas up to Sea State 3 and surf up to 7 ft (similar to existing causeways and other operational lighterage) within 30 min of side launch.



DESIGNATION:	P1	P2	P3	F5	F6
CONFIGURATION:	CSP PLUS 1 CAUSEWAY	CSP PLUS 2 CAUSEWAYS	CSP PLUS 3 CAUSEWAYS	MODULAR PONTOON BETWEEN TWO CAUSEWAY SECTIONS	3 CAUSEWAY SECTION
LENGTH (FT):	180	270	360	300	270
OVERALL WIDTH (FT):	21	21	21	24 OF MODULAR PONTOON	21
CREW:	8	8	8	11	11

Figure 2-16 - Causeway Ferry Configurations

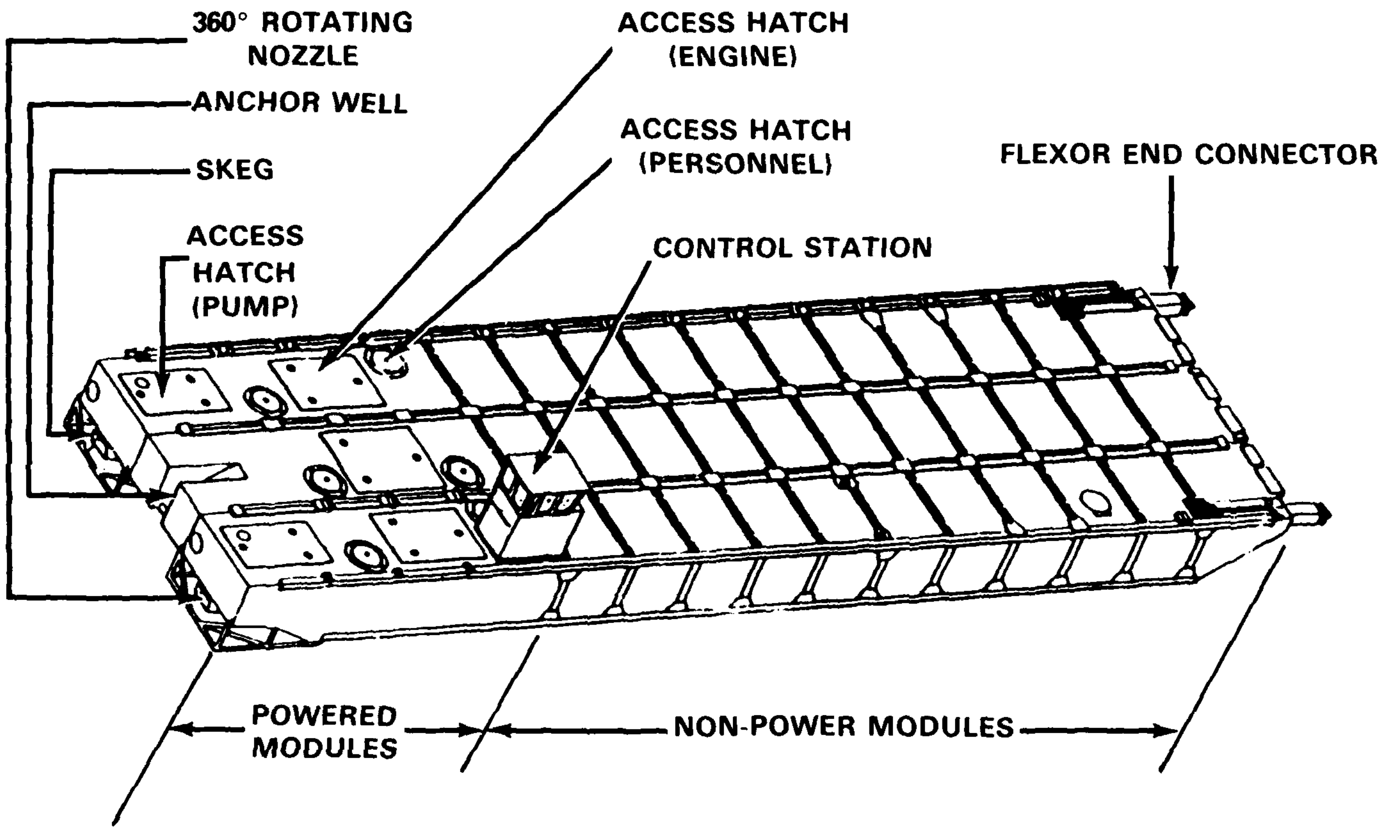


Figure 2-17 - Causeway Section, Powered

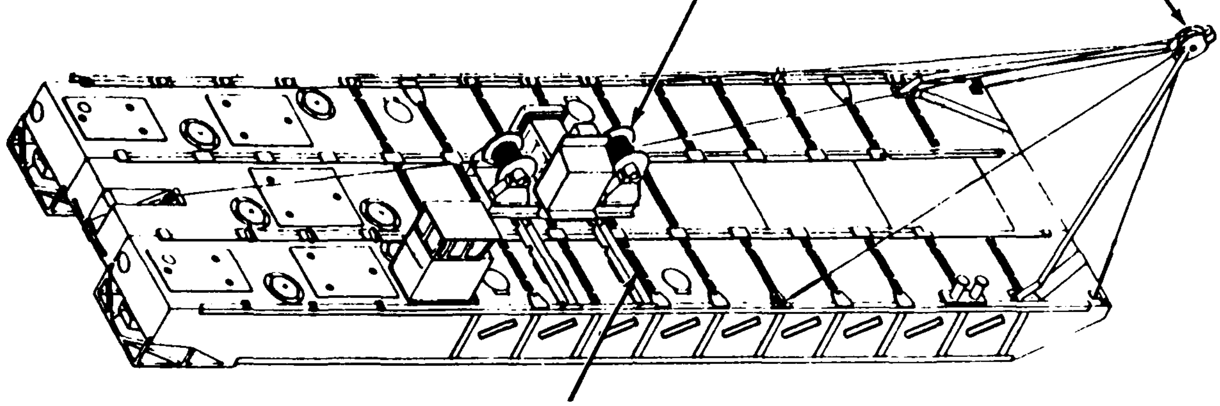


Figure 2-18 - Side-Loadable Warping Tug

TABLE 2-1 - CHARACTERISTICS OF INDIVIDUAL CAUSEWAY SECTIONS

	SLWT	CSP	Nonpowered Causeway Section	Prototype Modular Pontoon
Displacement (lb x 1000)				
Light	205	175	138	200
Full Load	205	245	318*	590*
Length (Ft)	84	91	92	120
Beam (Ft)	21	21	21	24
Draft (Full Load-Inches)	40	40	48*	42*
*Based on a 1-ft Freeboard Limit				

- Capable of operating in the surf zone and in debris-infested waters with a minimum degradation in thrust and maneuverability.

• Capable of developing speeds of 8 knots in a single section (light) and 6 knots in a four-section causeway (light) configuration.

• Capable of being highly maneuverable offshore, in the surf, and in beaching/retracting operations .

• Capable of continuous operations for 10 hr without refueling.

The Landing Craft Utility (LCU 1600 Class) were used to move 20-ft containers from T-ACS-1 directly to the beach for offload by the Marine Corps LACH. The LCU's also are capable of moving 20-ft containers to the ELCAS for offload by crane. Mechanized Landing Craft (LCM)-8's were utilized to move palletized breakbulk cargo from the SS CAPE ANN to the beach for forklift offloading. LCM-6 craft from the USS RALEIGH were used to transport personnel to and from the anchored ships and a floating causeway pier at the beach. The general characteristics of these craft as configured for the test are shown in Figure 2-19. Other support craft were used such as LARC-V's for personnel transfer and beach master functions and, the old style warping tugs for ACB-2 support functions.

2.3.2.2 Navy/USMC Beach Dry Cargo Discharge

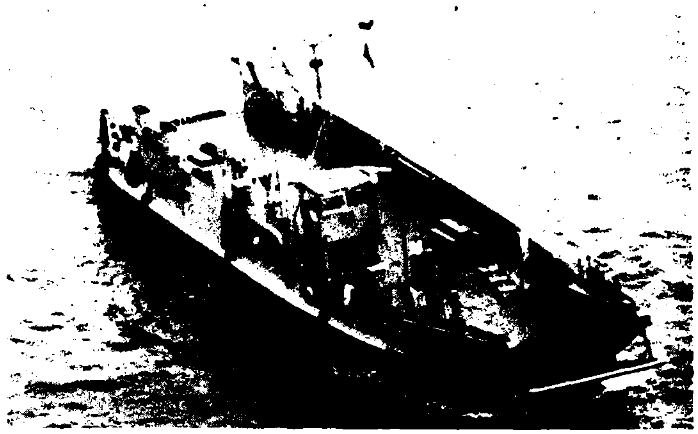
Dry cargo operations at the beach were conducted using the following systems/major equipment to offload the Navy lighters:

Beach System/Major Equipment	Cargo
ELCAS	20-Ft Containers
LACH	20-Ft Containers
RTCH	20-Ft Containers
RTFL (10,000 lb capacity)	Breakbulk

2.3.2.2.1 Elevated Causeway Facility (ELCAS)

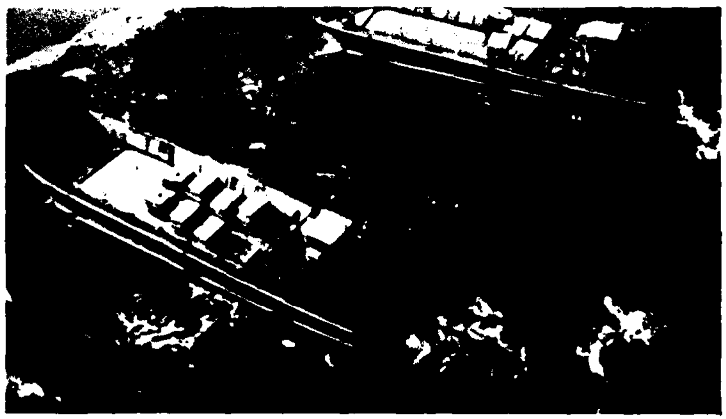
The ELCAS is intended to provide a means of delivering containers, vehicles, and bulk cargo ashore without the lighterage contending with the surf zone. The ELCAS configuration provided in JLOTS II consisted of 12 causeway sections hydraulically lifted on piles above the surf. The ELCAS extended approximately 800 ft from the shore. Six sections are joined end-to-end to form the roadway. The last 6 seaward sections are side-connected (two sections wide) providing a platform (pierhead) for a

Displacement:	174-LT - hoisting
	342-LT - full load
Length:	135-1/4 ft
Beam:	29 ft
Draft:	3-1/4 ft fwd, 6-1/2-ft aft (max landing)
Propulsion:	2 twin diesels
	500 hp ea engine
	2 shafts
Speed:	11 knots - full load
Range:	1200 n. mi at
	8 knots with payload
Crew:	14



LCU-1600

Weight:	59.8-LT - hoisting
	113.45-LT - full load
Length:	73-7/12 ft
Beam:	21-1/12 ft
Draft:	5-1/6 ft - loaded
Propulsion:	2 twin diesels
	325 hp ea engine
	2 shafts
Speed:	9 knots
Range:	190 n. mi at 9 knots
Crew:	5



LCM-8 (Steel)

Weight:	23.9-LT - hoisting
	54.2-LT - full load
Length:	56 ft
Beam:	14-1/3 ft
Draft:	3-1/2 ft loaded
Propulsion:	2 diesels 165 hp ea
	2 shafts
Speed:	9 knots - full load
Range:	130 n. mi at 9 knots
Crew:	5

LCM-6

Figure 2-19 - LCU-1600, LCM-8, and LCM-6 Characteristics

140-ton mobile crane and an air-bearing turntable. The turntable is used to rotate tractor/trailers which have been driven to the pier-end from shore. Once the tractor/trailer has been rotated, it is loaded by the crane with a container from lighterage brought alongside the pierhead from the T-ACS ship. Breakbulk and/or rolling stock can also be handled by ELCAS from lighters, although this was not demonstrated during the Throughput Test. Figure 2-20 shows the ELCAS configuration tested.

The 12 causeway sections of the ELCAS are each nominally 90-ft long and 21-ft wide. The sections are joined together to form the ELCAS. The roadway sections have external spudwells attached to hold the pilings which are used to elevate and hold these sections above the water and surf. The pierhead sections have internal spudwells to hold the pilings. Two 8-ft x 30-ft beach ramps were provided for roadway access to the beach.

The air-bearing turntable is used to turn trailers and their tractors around at the seaward end of the ELCAS so that they may be loaded and driven back to shore. The turntable is 48-ft in length and is capable of rotating a balanced load of approximately 80,000 lb, 180 deg in about 30 sec using an external air source of approximately 365 cu ft per min at 100 lb per square inch. The total weight of the turntable is 36,000 lb. The upper assembly is rotated pneumatically through an air motor and chain drive.

A fender system is installed on one side of the pierhead to absorb berthing impacts against the pierhead piling by cargo lighters. It has three 1 x 15 Navy Lightered (NL)-pontoon sections with foam-filled fenders attached to the outboard side. These pontoon sections are end-connected and held in place by additional piling driven through internal spudwells, and therefore rise and fall with the tides.

A container handling crane of 140-ton rating with a 90-ft boom is used for lifting containers from lighters moored at the fenders and placing them on tractor/trailers waiting on the causeway pierhead. The crane weighs 96 tons and is rubber-tired with 4 extendable outriggers.

2.3.2.2.2 LACH

The LACH is a two-wheeled, straddle lift, hydraulically operated container handling device developed by the USMC for offloading 20-ft

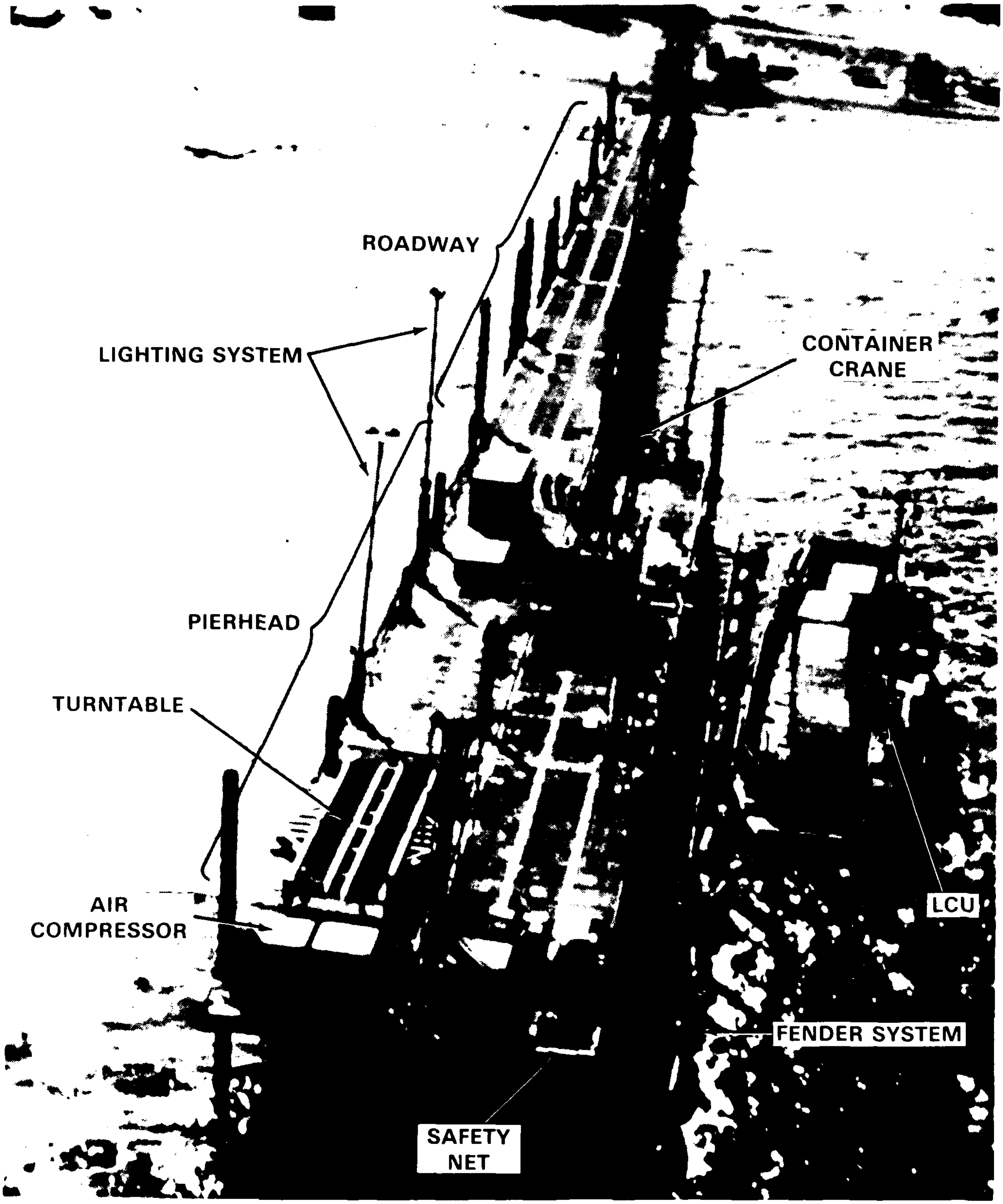


Figure 2-20 - Elevated Causeway Arrangement

containers from beached lighterage. For propulsion, it is typically hitched to the front of a crawler-tractor.

During JLOTS II, the LACH was pushed aboard an LCU where it straddled a container and then lifted it with a hydraulically operated spreader bar, as shown in Figure 2-21. The LACH then departed the lighter and positioned the container onto a trailer for transit to the Marshalling Yard. Two LCU landing points were established for the test with two LACH's servicing each landing point. LACH's were operated in soft sand as well as the surf zone.

Figure 2-21 - LACH Extracting Container from Beached LCU

The LACH can be deployed on commercial or Navy ships and transferred to the beach in a landing craft. LACH characteristics are listed below:

Payload:	50,000 lb	Height:	19 ft (travel mode, 10 ft)
Weight:	40,000 lb	Width:	13.2 ft
Length:	35 ft		

Operating personnel include:

1 - Hydraulic Lift Operator
1 - Spreader Frame Operator, or
2 - Spreader Bar Hook Operators

Lighterage Compatibility:

LCU
LCM-8 (not tested during JLOTS II)
Causeway Ferry (longitudal container orientation, not tested during JLOTS II).

2.3.2.2.3 RTCH

Rough Terrain Container Handlers (RTCH) were used to transfer 20-ft containers from beached Causeway Ferries (top view of Figure 2-22) onto trailers for transport to the Marshalling Yard. Two Causeway Ferry beach landing points were established for the test with two RTCH's servicing each landing point.

The RTCH utilized during the test are designed to handle ISO standard commercial and military containers weighing up to 50,000 lb. They have the capability of lifting 20, 35, and 40-ft containers by changing top handlers. They can side shift, forward and back tilt, and oscillate the carriage to provide precise and efficient control of the container. The RTCH can ford up to 60 in. of water and traverse soft uneven terrain. The RTCH is capable of stacking containers two-high in Marshalling Yards and has an effective turning radius of less than 50 ft.

The Marine Corps operators used during the test were engineer equipment operators. Since the RTCH is a new item in the Marine Corps' inventory, they received initial training on the RTCH just prior to the test. The RTCH is shown loading a container on a trailer in Figure 2-22.

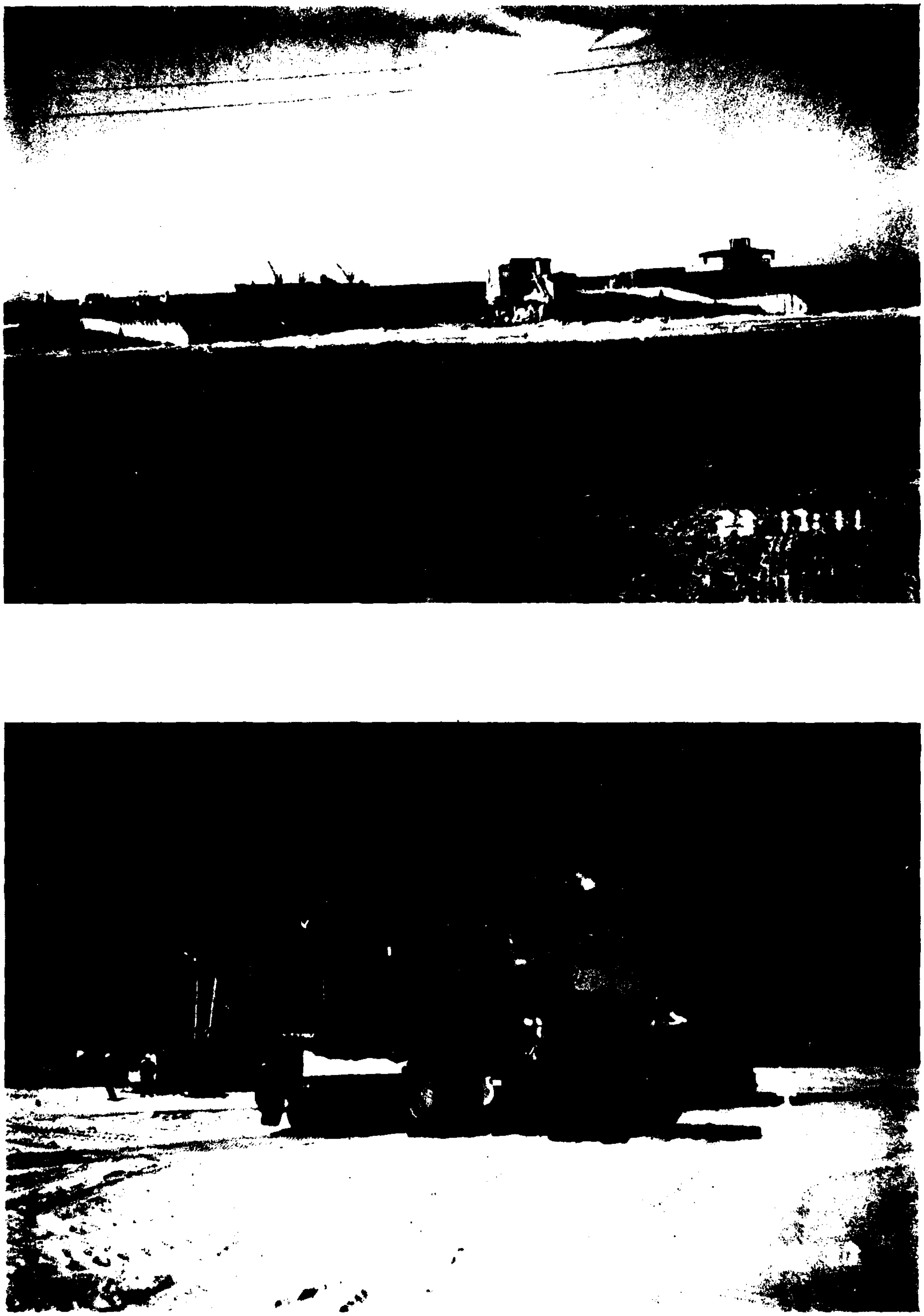


Figure 2-22 - RTCH

2.3.2.3 USMC Beach Dry Cargo Clearance, Cargo Marshalling, and Documentation

The Marine Corps employed a combination of M127 trailers and M931 tractors for transport of containers from the beach to the cargo marshalling areas. Five-ton trucks were employed for breakbulk cargo transport.

At the marshalling areas, the Marine Corps employed 30-ton Drott cranes and RTCH's for containers, as well as 6000-lb and 4000-lb capacity Rough Terrain Forklift (RTFL) for breakbulk cargo.

The Marine Corps employed the Marine Corps Automated Cargo Throughput Documentation System (MACTDS) and a manual system for documentation of cargo movement during JLOTS II. MACTDS is an automated tracking system which identifies a container and its contents as it is stuffed at a conus supply depot, shipped to port of embarkation, loaded aboard ship, offloaded, and distributed to ground and aviation supply locations throughout the amphibious objective area (AOA) in support of the Marine Air-Ground Task Force (MAGTF). Additionally, the manual system provided a back-up capability to the automated program.

2.3.2.4 Navy/USMC POL Systems

The Navy/USMC POL operations involved the installation and operation of the offshore Navy Amphibious Assault Fuel Supply Facility (AAFSF) and the shoreside USMC Amphibious Assault Fuel System (AAFS).

The AAFSF, as shown in Figure 2-23 consists of:

- Three Towable Fuel Bladder Assemblies (Type-L Dracones).
- Five 20,000 lb Propellent Embedment Anchors (PEA) for holding Dracones.
- A floating fuel pump in a buoy.
- Up to 5000 ft of longitudinally reinforced 6-in. inside diameter buoyant fueling hose on a hose reel.
- A Mobile Electric Power (MEP) unit located onshore to provide power for the floating fuel pump.

Each Towable Fuel Bladder is made of reinforced rubber fabric and has a total capacity of 135,000 gal with a maximum working capacity of 120,000 gal and a draft of 10 ft.

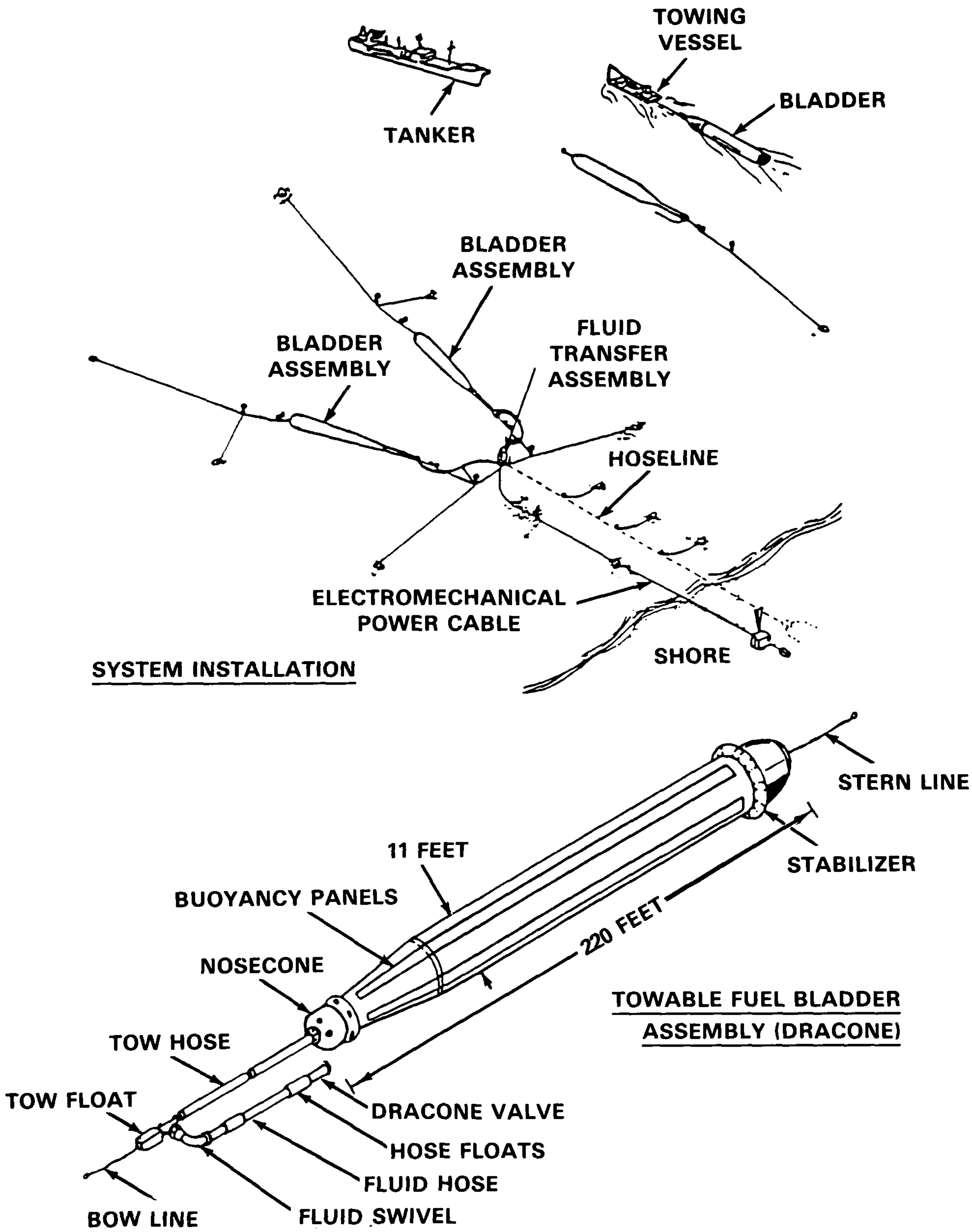


Figure 2-23 - Amphibious Assault Fuel Supply Facility

The AAFS has five tank farm assemblies each consisting of six 20,000 gal fabric tanks. Another 120,000 gal may be stored in the fabric tanks located at the booster station, giving each AAFS a total capacity of 720,000 gal. Normally, there are eight AAFS per company with two companies per Marine Amphibious Force (MAF), resulting in a total bulk fuel storage capacity of approximately 11 million gal per MAF.

During JLOTS II, one tank farm assembly of the AAFS, consisting of six 20,000 gal tanks, was installed.

2.3.3 Army Ship-to-Shore Discharge Systems

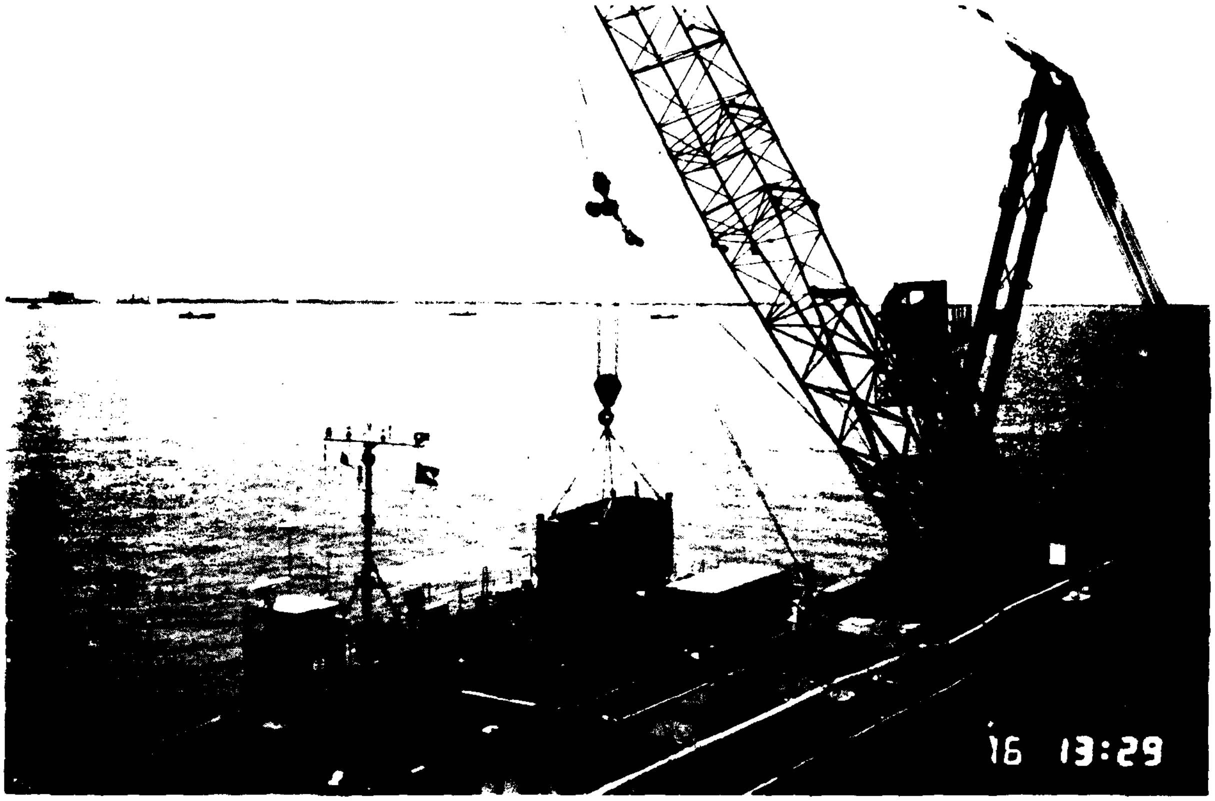
Section 2.3.1 described the commercial ships which carried the dry and liquid cargos to be used in the test. The major systems and equipment used by the Army in handling and transporting this material to the beach and/or Marshalling Yard (container and breakbulk cargo) are described in the following subsections.

2.3.3.1 Army Temporary Container Discharge Facility (TCDF)

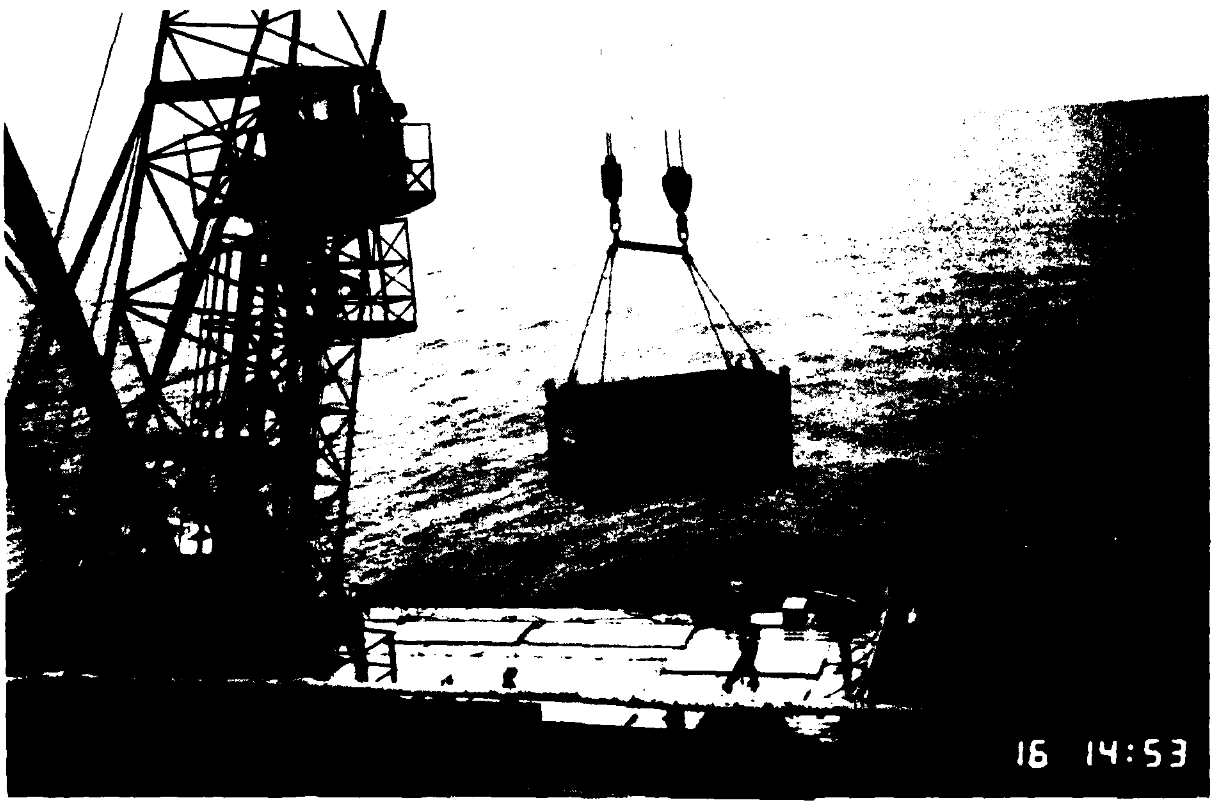
The Army's TCDF consists of a P&H 6250, 250/300 STon lifting capacity crane mounted on a B-Delong barge. Two TCDF barges, operated by Transportation Terminal Service Company (container) personnel were towed and moored alongside the SS EXPORT LEADER with Army tugs after the T-ACS operations were completed. The total weight of the TCDF is approximately 775 STons. The crane with a 130-ft boom makes up approximately 180 STons. The B-DeLong barge measures 150-ft by 60-ft; the P&H 6250, 66.1-ft by 12-ft by 13.5-ft. Figure 2-24 shows the TCDF's. One TCDF was equipped with a Rider Block Tagline System for load pendulation control, while the other TCDF did not have a Rider Block Tagline System, but was configured with a load equalizing beam.

2.3.3.2 Army Lighterage and Support Craft

The Army used conventional landing craft; LCU 1466 CL, 1667 CL, 1671 Class (CL), and amphibians; LARC-LX's, and LACV-30's to move containers. The LARC-LX's, and LACV-30's are amphibians currently in the active Army inventory which transport containers directly onto the beach while the LCU's moved containers to an Army pier system. LCM-8's and LARC-LX's were the primary carriers of breakbulk cargo which was offloaded by forklift



Army TCDF with RBTS



Army TCDF without RBTS

Figure 2-24 - Army TCDF

trucks (RTFL, 10,000 lb capacity) in the surf zone. Detailed descriptions of the Army lighterage used are provided in Figures 2-25 through 2-29 and Tables 2-2 through 2-6.

2.3.3.3 Army Dry Cargo Beach Discharge

DeLong Piers were used to project a shoreline transfer point past part of the surf zone. DeLong Piers are steel barges modified with a series of 6-ft diameter caissons. The piers were towed into position by Army lighters and then caissons were jacked down through spudwells into the sea floor to the barge and to create an elevated platform. Bridging ramps were used to enable vehicles to drive on and off.

The Army installed two sizes of DeLong Piers (Figure 2-30). An A-DeLong Pier is 300 ft by 80 ft and normally has ten caissons. The B-DeLong Pier is 150 ft by 60 ft and normally has six caissons. The A-DeLong Pier is too large to be transported by existing U. S. Flag sealift vessels. It must be ocean-towed at a maximum speed of five knots. The pier is structurally inadequate for safe ocean-tow with mobile cranes onboard. Mobile cranes were transported on the DeLong Pier to the test site at Fort Story. Two 140-ton truck mounted cranes, as shown in Figure 2-30, transferred containers from LCU's moored alongside the A-DeLong onto truck/trailers for transport to the Marshalling Yard.

In addition to the DeLong Pier, the Army used a separate amphibian discharge site for the LACV-30's and LARC-LX's. Truck-mounted, 140-ton cranes were used to unload these amphibian vehicles (Figure 2-31) and RTCH's used to load the trailers.

Palletized breakbulk cargo discharge at the beach was accomplished by the use of 10,000 lb RTFL and 6,000 lb RTFL, as shown in Figures 2-32 and 2-33 to unload the LCM-8's and LARC-LX's. RTFL's (6,000 lb and 4,000 lb) then loaded the breakbulk cargo onto trucks.

2.3.3.4 Army Beach Dry Cargo Clearance, Cargo Marshalling, and Documentation

Twenty-ft trailers (M871) and 40-ft trailers (M872) with tractors (M127 and M878A1) were employed for transport of breakbulk and container cargo from the beach to the cargo marshalling area. At the marshalling areas, 50,000 lb Rough Terrain Container Handlers (RTCH) (Figure 2-34),

Figure 2-25 - Landing Craft, Mechanized (LCM-8)

TABLE 2-2 - CHARACTERISTICS OF LCM-8

Crew	6	Cargo	
		Capacity	53.5 LT
Speed			
Light	11 Knots	Cargo	
Loaded	9 Knots	Space	
		Length	42'9"
Range		Width	14'6"
Light	332 NM		
Loaded	271 NM		
		Ramp	
Fuel		Opening	14'6"
Capacity	864 Gal		
Consumption	34.16 GPH		

Draft					
Light					
Forward	3'	Mean	3'3"	Aft	3'6"
Loaded					
Forward	3'	Mean	4'	Aft	5'

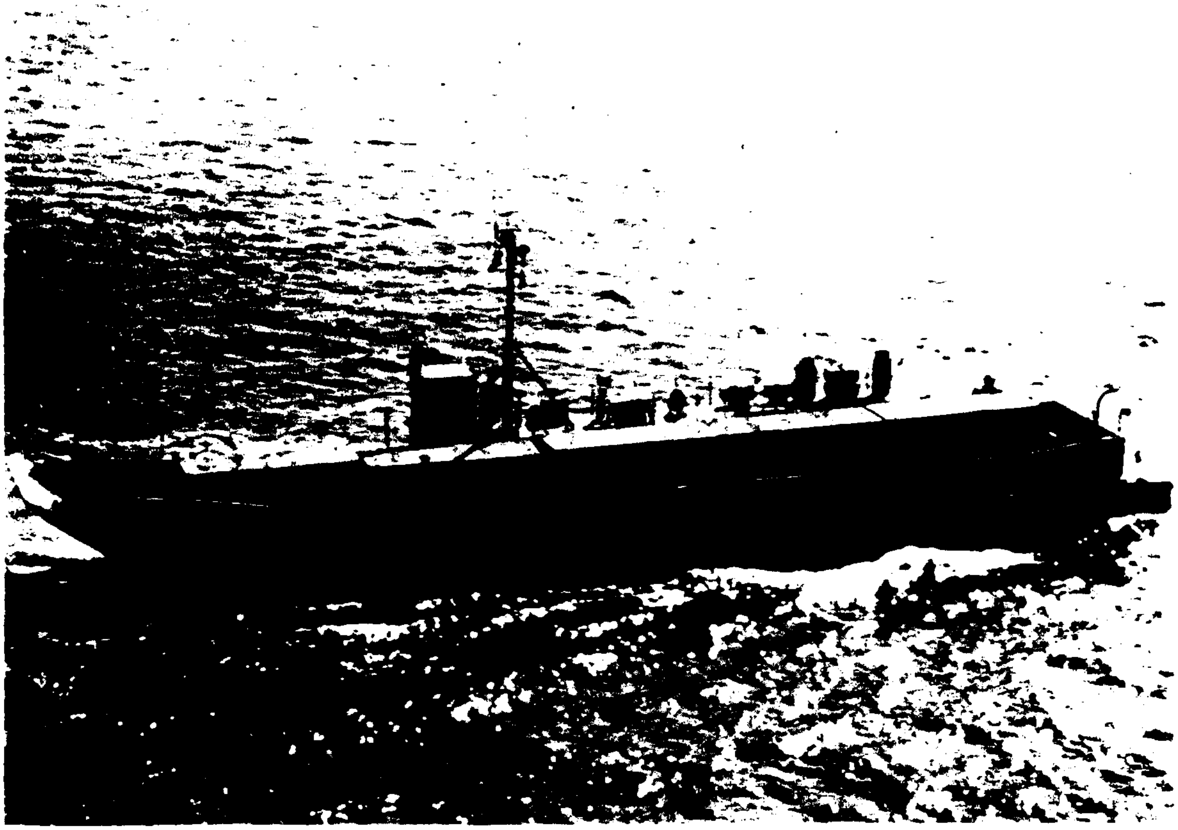


Figure 2-26 - Landing Craft, Utility (LCU-1667, 1671)

TABLE 2-3 - CHARACTERISTICS OF LCU-1667/1671

Crew	14	Cargo Capacity	184 LT
Speed			
Loaded	11 Kt	Cargo Space	
		Length	105′
Range		Width	17′*
Loaded	1200 NM		
Fuel		Ramp Opening	15′1"
Capacity	3290 Gal		
Consumption	36 GPH		
Draft - Loaded			
Forward	4′	Aft	6′7-1/2"

*17′at narrowest point.

Figure 2-27 - Landing Craft, Utility (LCU-1466)

TABLE 2-4 - CHARACTERISTICS OF LCU-1466

Crew	14	Cargo Capacity	167 LT
Speed Light	8.0 Kt	Cargo Space Length	52′*
Range	1200 NM @ 6 Kts	Cargo Space Width	29′6"
Fuel Capacity	3542 Gal	Ramp Opening	14′4"
Fuel Consumption	34 GPH	Length	115′
		Beam	34′
Draft Forward	2′9"	Draft Aft	5′3"

*Additional space forward 22′ length by 14′4" width.

Figure 2-28 - Lighter, Amphibious Resupply Cargo (LARC-LX)

TABLE 2-5 - CHARACTERISTICS OF LARC-LX

Crew	8	Cargo Capacity:	60 ST
		Emergency:	100 ST
Water Speed			
Light	6.52 Kt	Cargo	
60 ST Load	6.08 Kt	Space	
100 ST Load	5.65 Kt	Length	42'6"
		Width	13'8"
Land Speed			
Light	15.2 MPH		
60 ST Load	14.0 MPH	Ramp	
100 ST Load	12.8 MPH	Opening	14'6"
Reverse 60 ST	5.0 MPH		
Range (w/60 ST)			
Water	75 NM		
Land	150 SM	Gradient	40%
Fuel			
Capacity	600 Gal		
Consumption	38 GPH		

Draft						
Light	Forward	6'8"	Mean	6'8"	Aft	7'5"
Loaded	Forward	8'2"	Mean	8'5"	Aft	8'8"

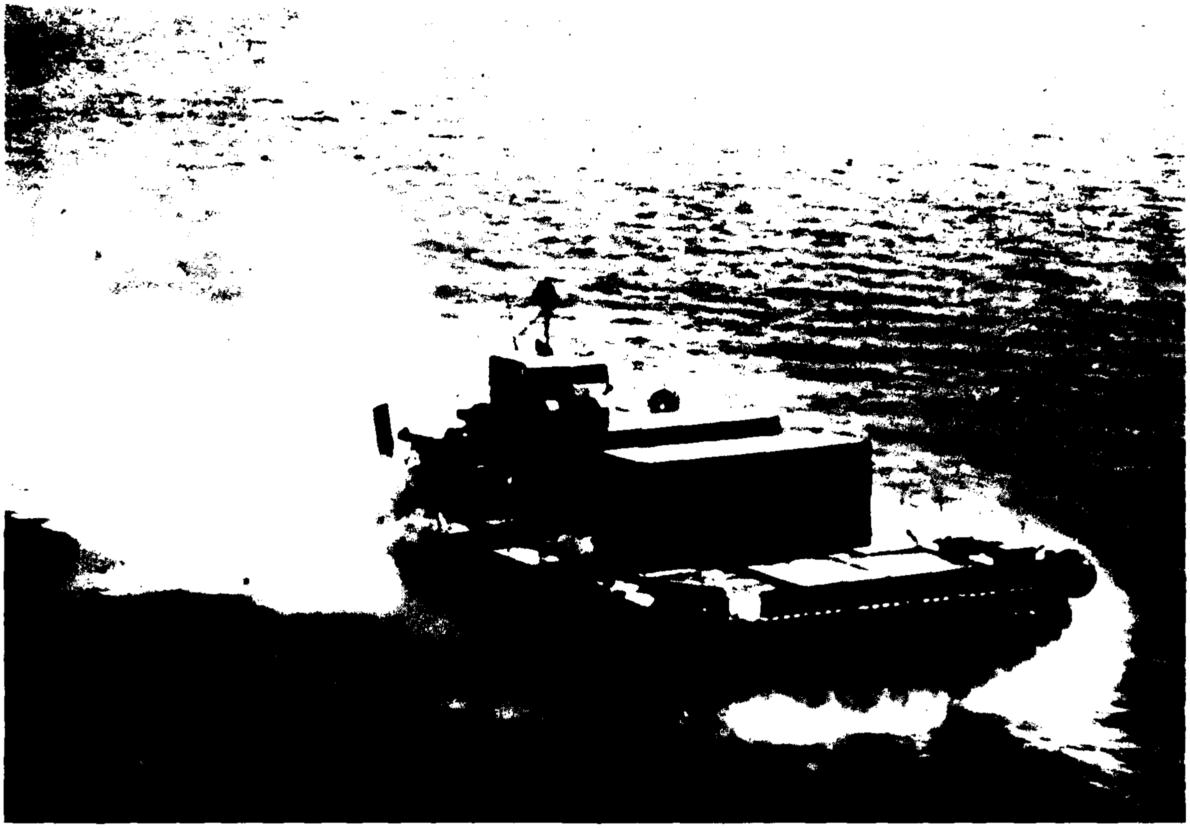


Figure 2-29 - Lighter, Air Cushioned Vehicle (LACV-30)

TABLE 2-6 - CHARACTERISTICS OF LACV-30

Crew	8	Cargo Capacity	
Speed (calm water)		Payload (including fuel)	30 ST
Light, Max	62 MPH	20′ Containers	2
With 1 Container	30 MPH		
With 2 Containers	22 MPH		
		Cargo Space	
Range		Length	51′6"
30.0 ST	2.0 Hr	Width	32′6"
27.3 ST	5.0 Hr		
23.7 ST	9.1 Hr	Draft:	None. Operates in up to 8′ plunging surf and over 4′ land/water obstacles.
Fuel Capacity			
Main	2240 Gal		
Ballast/ Emergency	1530 Gal	Note:	The characteristics, operation, and maintenance of the LACV-30 are more similar to a helicopter than a maritime vessel.
Fuel Consumption			
Cruise	260 GPH		
Normal Mission	150 GPH		

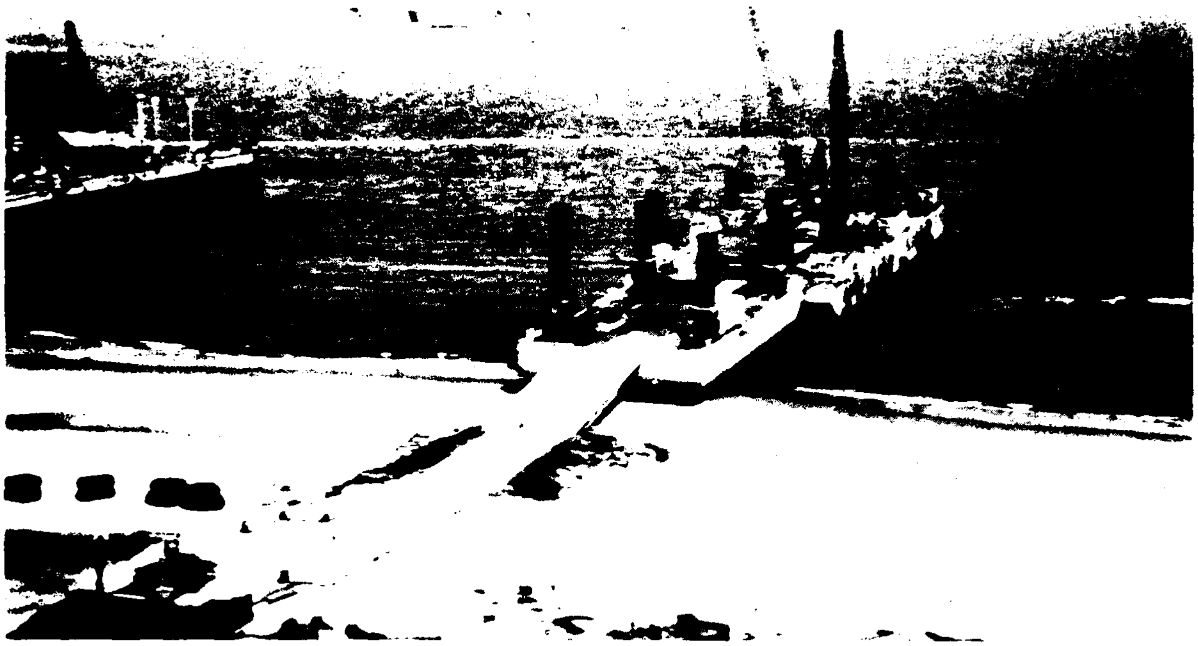


Figure 2-30 - DeLong Piers

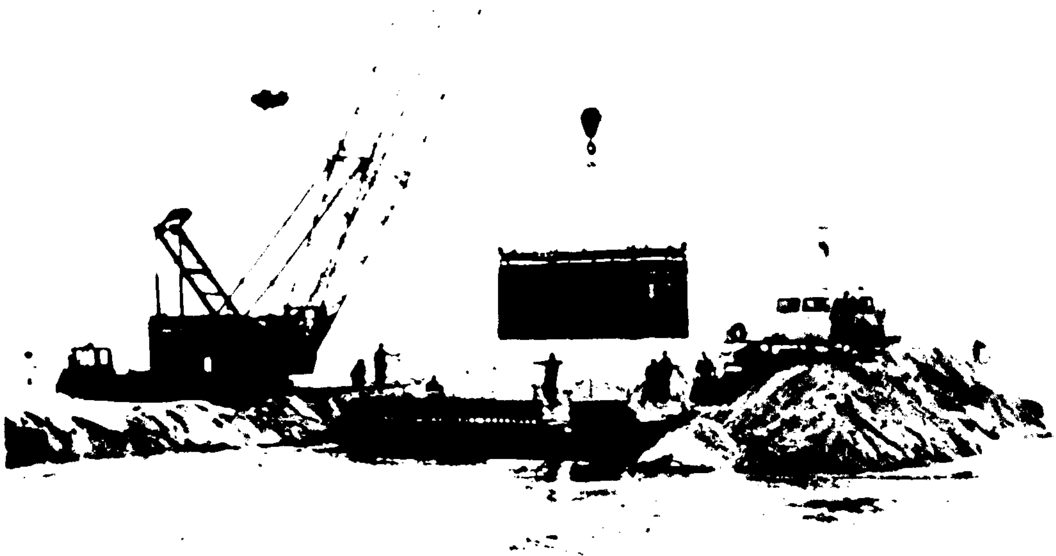


Figure 2-31 - 140-Ton Truck-Mounted Crane, Container Handling

Figure 2-32 - Rough Terrain Forklifts, 10,000 Pounds
for Handling Breakbulk Cargo

Figure 2-33 - Rough Terrain Forklift, 6,000 Pounds
for Handling Breakbulk Cargo

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TEST AND EVALUATION..(U) NAVAL AMPHIBIOUS BASE LITTLE
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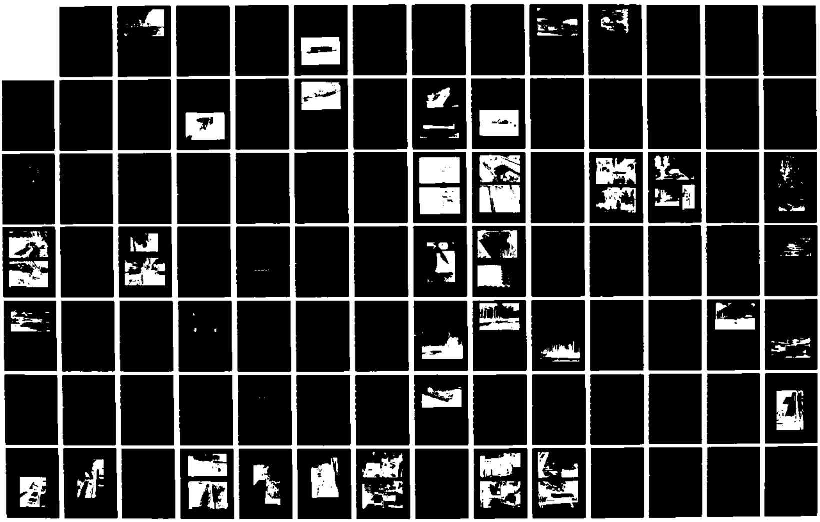

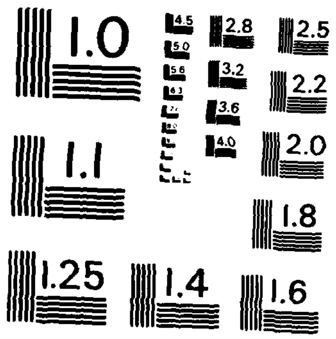

MICROCOPY RESOLUTION TEST CHART
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Figure 2-34 - RTCH Unloading Containers at Marshalling Area

were used to handle containers, and 4,000 lb RTFL were used to handle palletized breakbulk cargo.

The Army employed the Automated Cargo Documentation System (ACDS) for documentation of cargo movement during JLOTS II. This system provides automated processing capabilities to ocean terminal operations overseas. It provides support for time consuming manual documentation and cargo accountability procedures.

2.3.3.5 Army POL and Water Systems

Prior to the test, an environmental assessment and review was accomplished by the Directorate of Engineering and Housing, Fort Eustis, Virginia. Environmental assessments for similar operations were reviewed and permits required by law or regulation were obtained. Approval of permits required coordination with the Virginia Marine Resources Commission, the Virginia State Water Control Board, the U.S. Army Corps of Engineers, and the U.S. Coast Guard. Emphasis was directed to the cleaning protocol for the tanker, disposal of water used for the test, and regulatory requirements associated with installation of explosive embedment anchors (EEA).

Four sub-systems of the Army Tactical Marine Terminal (TMT), the newly developed MLMS anchors and the new BFTA, were planned for installation and testing during JLOTS. These systems were:

- Tactical Marine Terminal (TMT) Anchorage
- Multi-Leg Mooring System (MLMS) Anchorage
- Six-Inch Floating Hoseline
- Six-Inch Bottom-Lay Steel Pipeline
- TMT Onshore Storage and Delivery Module
- Bulk Fuel Tank Assembly (BFTA)

Water purification and transfer was demonstrated using the prototype Reverse Osmosis Water Purification Unit (ROWPU).

TMT Anchorage. The TMT anchorage normally consists of a four-point spread moor. Each leg consists of one 6,000 lb drag embedment anchor, one 10,000 concrete block and associated wire and chain. During JLOTS II, two TMT anchors were used in conjunction with the tankers bow anchors to make a 4-point spread moor.

MLMS Anchorage. The MLMS anchorage consists of four XM-50 Explosive Embedment Anchors (EEA's) which would be combined with the tankers bow anchors to provide a six-point spread moor for the tanker. The EEA's were installed utilizing a motor surf boat and a Mooring Leg Deployment Device (MLDD). The EEA is furnished with a probe which will fire the anchor upon contact with the bottom. The explosively embedded anchor projectile is connected to the MLDD by a pendant which is an 80-ft length of coated nylon rope. The pendant functions as a shock absorber diminishing the mooring loads which a moored tanker imposes on the embedded anchor projectile. The MLDD is normally used to set the EEA by use of its winch, but during JLOTS II the EEA's were set and then pull-tested using an Army Cube Barge. The MLDD's remain attached to the pendant to act as a mooring buoy.

Six-Inch Floating Hoseline. The 6 in. floating hoseline consisted of 5,000 ft of 6-in. rubber hose supported longitudinally by an external span wire. It comes in 50-ft sections which have been connected and stored on a large drum reel. Drag anchors are used at 200-ft intervals to anchor the hose as it is deployed from shore-to-sea by a Cube Barge. Buoys are used every 100 ft to mark anchor and hose locations, as the hose will sink when filled with fluid.

Six-Inch Bottom Lay Steel Pipeline. The six-inch pipeline system consists of 5,000 ft of 30-ft long threaded pipe sections which are screwed

together with threaded collars by power tongs. The pipe is joined in 90-ft sections on the beach and is pulled out as it is assembled using a Cube Barge. A hoseline is attached to the seaward end of the pipeline and a flotation collar is attached to the end of the hoseline.

Approximately 3,450 ft of pipeline was deployed from the beach to the MLMS site in JLOTS II. Subsequent damage to the riser hose and failures of the EEA's prevented pumping of water through the pipeline.

TMT Onshore Module. The TMT onshore module is a temporary fuel-handling system designed for the receipt, storage, and issue of bulk petroleum products to support forces deployed to an undeveloped theater. The system may also be employed in other areas where permanent petroleum port facilities are inadequate or have been damaged or destroyed. The TPT has a storage capacity of 2,100,000 gal (50,000 barrels) and may be arranged for support as required or necessary to fit the terrain, mission, or operational needs. Major shore components include:

- Forty-two 50,000 gal collapsible storage tanks
- Eight 600 gpm pumps
- Six 600 gpm filter/separators
- Fire suppression system
- Hoses, fittings, and dispensing equipment

For JLOTS II, one module consisting of eight 50,000 gal collapsible storage tanks was installed with three pumps, two filter/separators, and 15 distribution points. Additional pump stations and storage tanks were installed to transfer and store the water. A total of 320,000 gal were pumped to/from the TPT, 150,000 from the floating hoseline and 170,000 from the Navy's AAFSF.

BFTA. Two BFTA's were included in the cross base pumping and storage system of the TPT. These tanks have a capacity of 210,000 gal and are undergoing Army evaluation to provide the TPT with increased storage using fewer resources.

The tanks were installed and retrieved a total of four times. They were cross-connected with each other and the 50,000 gal storage tanks. Approximately 178,500 gal of water was temporarily stored in and then pumped between the tanks. It was then pumped back into the 50,000 gal tanks.

Reverse Osmosis Water Purification Unit Demonstration. The M231A ROWPU barge (Figure 2-35) is designed to provide water support to U.S. forces deployed to an area of the world where potable water is not immediately available. The Army barge has been redesigned for use as a potable water supply vessel with two ROWPU's and appurtenant structures/facilities for personnel assigned to operational and maintenance duties.

Recommended maximum anchoring distance from shore is 2,500 ft, with water depth not exceeding 3 fathoms. A four-point moor was used to ensure stability of barge position.

Water delivery capacity of the barge was rated at 300,000 gal per day. During the JLOTS II demonstration, the ROWPU barge was installed and placed into operation twice. Approximately 449,000 gal of water was produced during the demonstration.

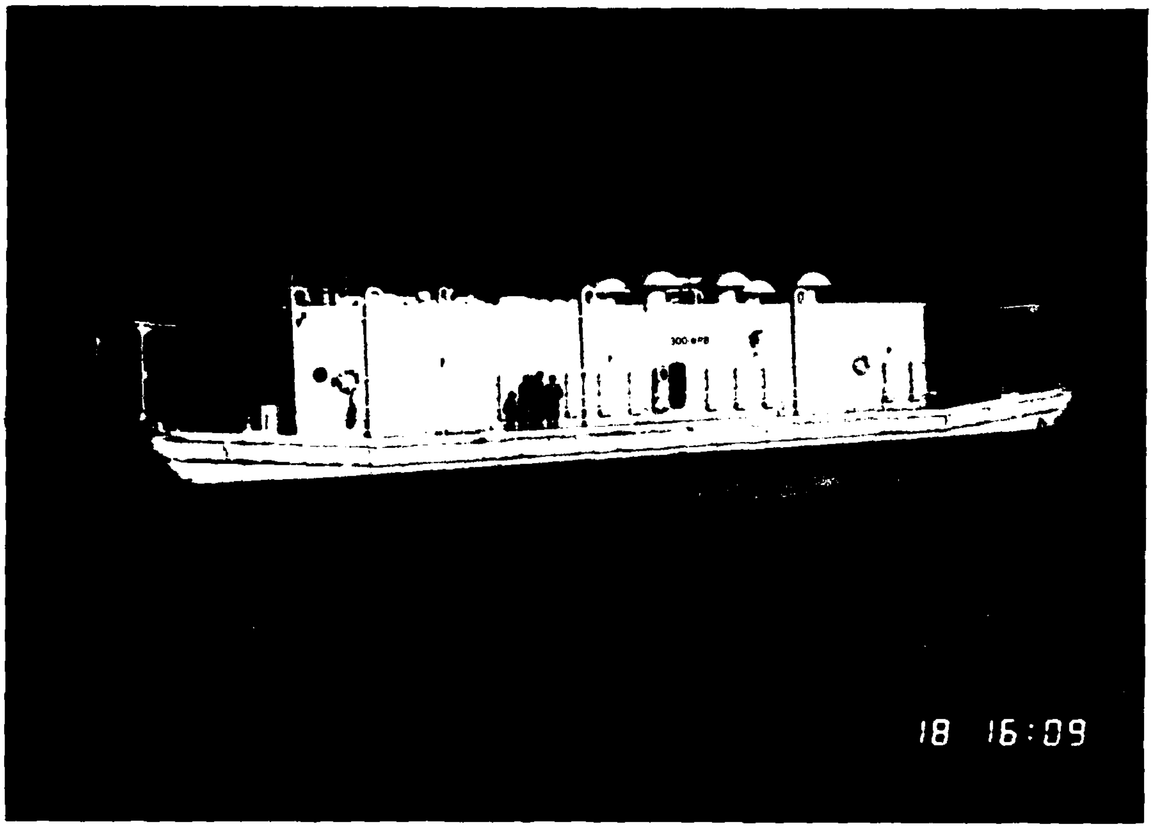


Figure 2-35 - Reverse Osmosis Water Purification Barge

2.4 PRETEST PREPARATIONS

Pretest preparation for the Throughput Test began approximately eighteen months prior to the test. The longest lead items were associated with acquiring 1,000 containers and sufficient cargo for stuffing the containers. Commercial ship charters were required for the containership, breakbulk ship, tanker, and a data collection system was developed to record quantitative and qualitative data without impacting the operations. Finally, site preparation was performed at Fort Story, Virginia.

2.4.1 Commercial Ships and Test Cargo

Commercial chartering procedures were required for the containership, breakbulk ship, and tanker. The chartering process, a responsibility of the Military Sealift Command (MSC) generally required about four months to complete. Requests for charter included a description of the test or exercise planned, cargo description, specific ship typed desired, charter dates, location and any test unique considerations. "Chartering of Ships for Sealift Exercise and Tests" (MSC Pamphlet 3300) provides detailed guidance for charter requests.

The charter process at MSC revealed that there were no NSS container ships under long term MSC charter available for the test. It was further determined through a market survey that commercial interest in this short-term charter was very limited and would result in a charter cost of approximately $2.5 million.

Analysis of the charter requirements revealed that if the mooring test was conducted independent of container operations using an operational containership or containership hull type of opportunity, a partially crewed ship from the Ready Reserve Force (RRF) could satisfy remaining test objectives. Total cost for this option was estimated to be approximately $0.5 million, or a $2 million saving over the commercial option. The latter option was selected.

The NSS containership used for JLOTS II was the SS EXPORT LEADER. Nine hundred thirty seven (937) 20-ft containers were stowed in her 40-ft cells. The ship was partially activated from the RRF and crewed by approximately 12 merchant mariners hired by a commercial operating company.

The Auxiliary Crane Ship (T-ACS) obtained for JLOTS was the SS KEYSTONE STATE. Fifty-five containers (20 ft and 40 ft) and 3 SEASHEDS with select outsize cargo items were preloaded for the test.

The breakbulk ship used for JLOTS II was the SS CAPE ANN. Approximately 2,100 STons of cargo was loaded at the James River Reserve Fleet Anchorage.

The tanker used for JLOTS II was the MV SEADRIFT. Three million gal of fresh water were used as liquid cargo for the test. Additional details concerning these ships are in Section 2.3.

Container Acquisition and Stuffing. Selection of test cargo for the throughput phase of JLOTS II was designed to simulate realistic AFOE and LOTS resupply scenarios. Recognizing the considerable volume and cost of providing actual military supplies and equipment for approximately one thousand 20-ft MILVANS and twenty 40-ft containers, surplus material from Defense Reutilization and Marketing Offices (DRMO) was obtained for all containers. Actual MILVAN weight distribution is summarized in Figure 2-36.

Breakbulk Cargo Acquisition. There were 1,951 training cargo pallets employed as breakbulk cargo for the Throughput Test. The palletized units consisted of metal ammunition cans filled with concrete and banded to standard warehouse pallets. Approximately 940 averaged 3,100 lb each, while the remainder ranged from 544 to 1,150 lb each. All pallets were provided by the 7th Transportation Group, Fort Eustis, Virginia.

2.4.2 Beach Preparations

Description of Roadway Design. The roadway design used for the Throughput Test was an oval shaped "racetrack" that permitted truck access to all dry cargo transfer sites on the beach (Figure 2-37). The roadway design allowed for one-way traffic on the racetrack with two connecting roads, one entering the beach and one departing the beach. Surfacing material used on the beach for the test were Sand Grid and MOMAT. Prior to the start of the test, both materials were installed by Army terminal service units augmented by Public Works personnel and equipment.

Sand Grid. Sand Grid is a new concept under development by the Army Corps of Engineers Waterways Experimentation Station, Vicksburg, Mississippi which involves the confinement of sand or sandy materials in

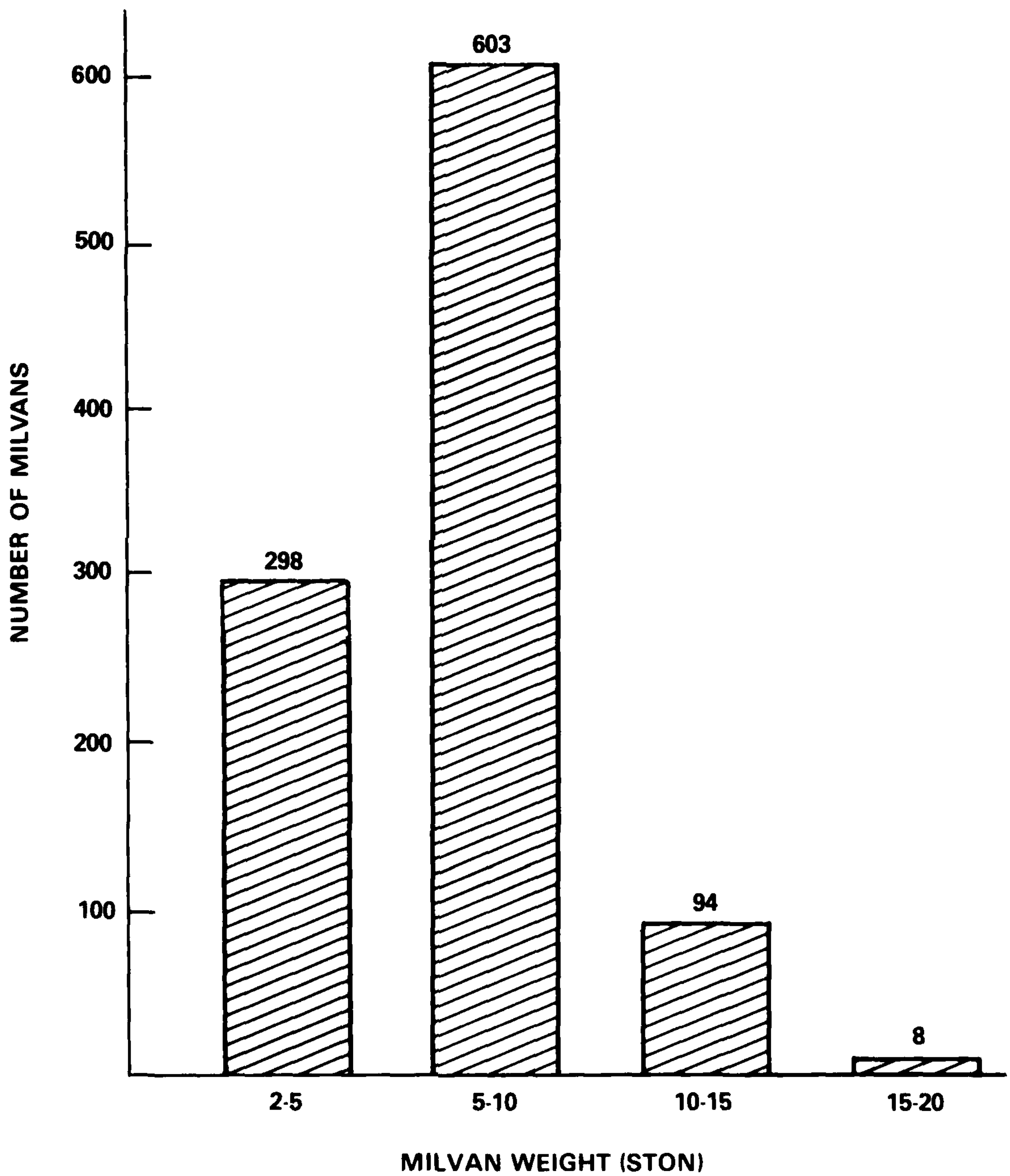


Figure 2-36 - JLOTS II MILVAN Weight Distribution

Figure 2-37 - Beach Roadway Layout

interconnected cellular plastic elements called grids. For the roadway application used in the test, 8-in. deep grid sections were placed on the beach, filled with sand, and the top of the grid sections were sprayed with liquid asphalt (RC 250) at a rate of approximately one gallon per square yard. This asphalt sealed Sand Grid road was capable of handling wheeled truck traffic including tandem axle loads up to 53,000 lb.

The Sand Grid road (Figure 2-38) used during JLOTS II was installed by Army and Public Works personnel using hand shovels, bulldozers, front-end loaders, and other equipment commonly used by military transportation and engineer units. Approximately 1.7 mi of Sand Grid was installed from 13-27 August 1984. Commercial equipment was used because suitable military equipment was unavailable from the local area.

Sand Grid is a relatively inexpensive material for roadways. The 1984 price of Sand Grid including support equipment and asphalt, averaged about $1.50 per sq ft. Sand Grid is also easily transported. Each grid section, when laid out, measures 8 ft wide by 20 ft long by 8 in. deep. When grid sections are compressed for shipping, the dimensions are 3-1/2 in. wide by

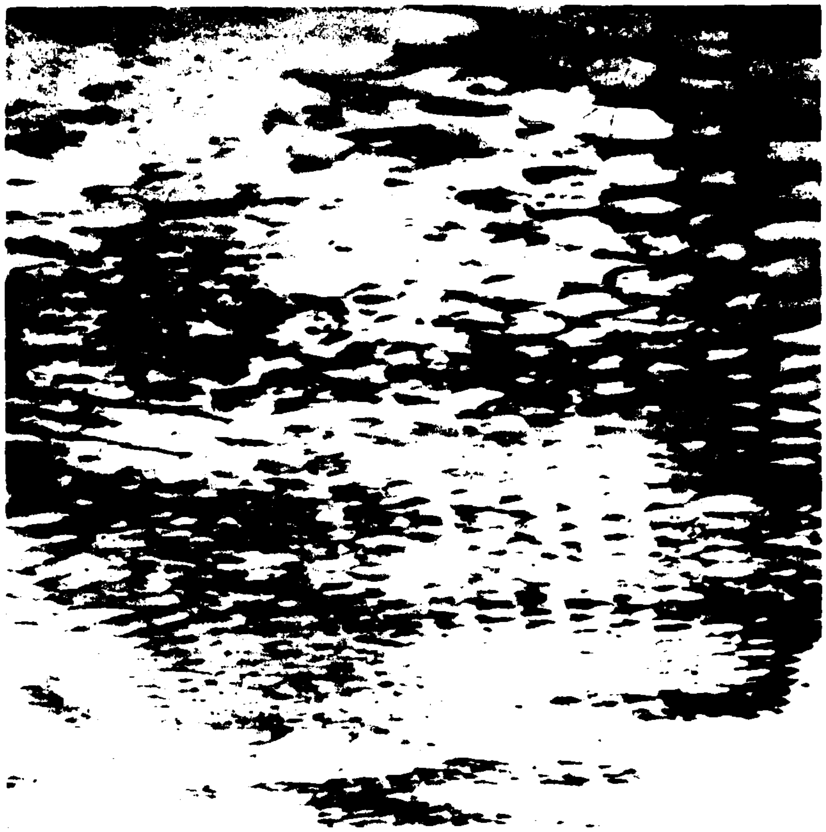


Figure 2-38 - Sand Grid Roadway

20 ft long by 8 in. deep. The cargo carrying capacity of two 40-ft flatbed trailers can transport 1 mi of Sand Grid.

Mobility Matting (MOMAT). To complete the "racetrack" design, MOMAT was used to interconnect and augment the Sand Grid roadway. The basic MOMAT system consists of 3 semi-rigid panels per kit which may be rolled out and bolted together to form temporary roadways. MOMAT panels are made from fiberglass reinforced resin material and are heat and pressure molded into a waffle-like pattern. The uniform, alternating profile of high and low surfaces provides stiffending and traction across loose, soft terrain. Each panel has an overall measurement of 48 ft 6 in. long by 12 ft 2 in. wide by 1/2 in. thick.

MOMAT was installed on the beach by rolling out and bolting panels together, end-to-end, until a panel overlapped the Sand Grid roadway. Once connected, the MOMAT was anchored to the sand using nylon line and metal stakes.

In contrast to Sand Grid, MOMAT is relatively expensive. The 1984 cost of MOMAT was about $14 per sq ft. Purchasing lead times for MOMAT averaged about 10 months.

2.5 MAJOR TEST EVENTS

The JLOTS II Throughput Test was conducted at Fort Story, Virginia at an undeveloped beach with no conventional fixed port facilities or deep draft piers. During a 31-day test period, Navy, Marine Corps, and Army units conducted over-the-shore operations of dry cargo, including containerized and palletized cargo, as well as bulk petroleum products, simulated for environmental purposes by fresh water. The scenario entailed a Navy/Marine Corps Assault Follow-On Echelon (AFOE) operation which transitioned to an Army Logistics Over-the-Shore (LOTS) operation. The schedule of actual test events is shown in Figure 2-39.

2.5.1 Container Operations

Container cargo operations were conducted at Fort Story, Virginia 20 September through 17 October 1984. During this period, 1,959 containers were offloaded from the containership and transferred to cargo yards.

After the containership was discharged, containers were retrograded back to the ship and the process was repeated. As shown in Figure 2-40, container retrograde operations were conducted during 7 days of the test. Daily container movements for the NAVY/USMC are described in detail in Section 3.2.1 and Table 3-9. Daily container movements for the Army are described in detail in Section 5.2.1 and Table 5-12.

Weather and sea state limitations resulted in the loss of about 14 days, leaving a total of only 10 days for offload operations. However, as shown in Figure 2-41 during this 31-day period, sea conditions in excess of Sea State 3 were experienced only 10 percent of the time (about 3 days). Therefore, 29 percent of the time (about 11 days) Sea State 3 conditions existed and operations which were expected to continue were, for the most part, cancelled because of safety concerns, and equipment and procedural deficiencies.

2.5.2 T-ACS/Lighter Operations

The T-ACS operation was served by Navy Causeway Ferries, in various configurations, Navy and Army LCU's, Army LARC LX's, and the Army LACV-30's. Each craft demonstrated unique capabilities which are discussed

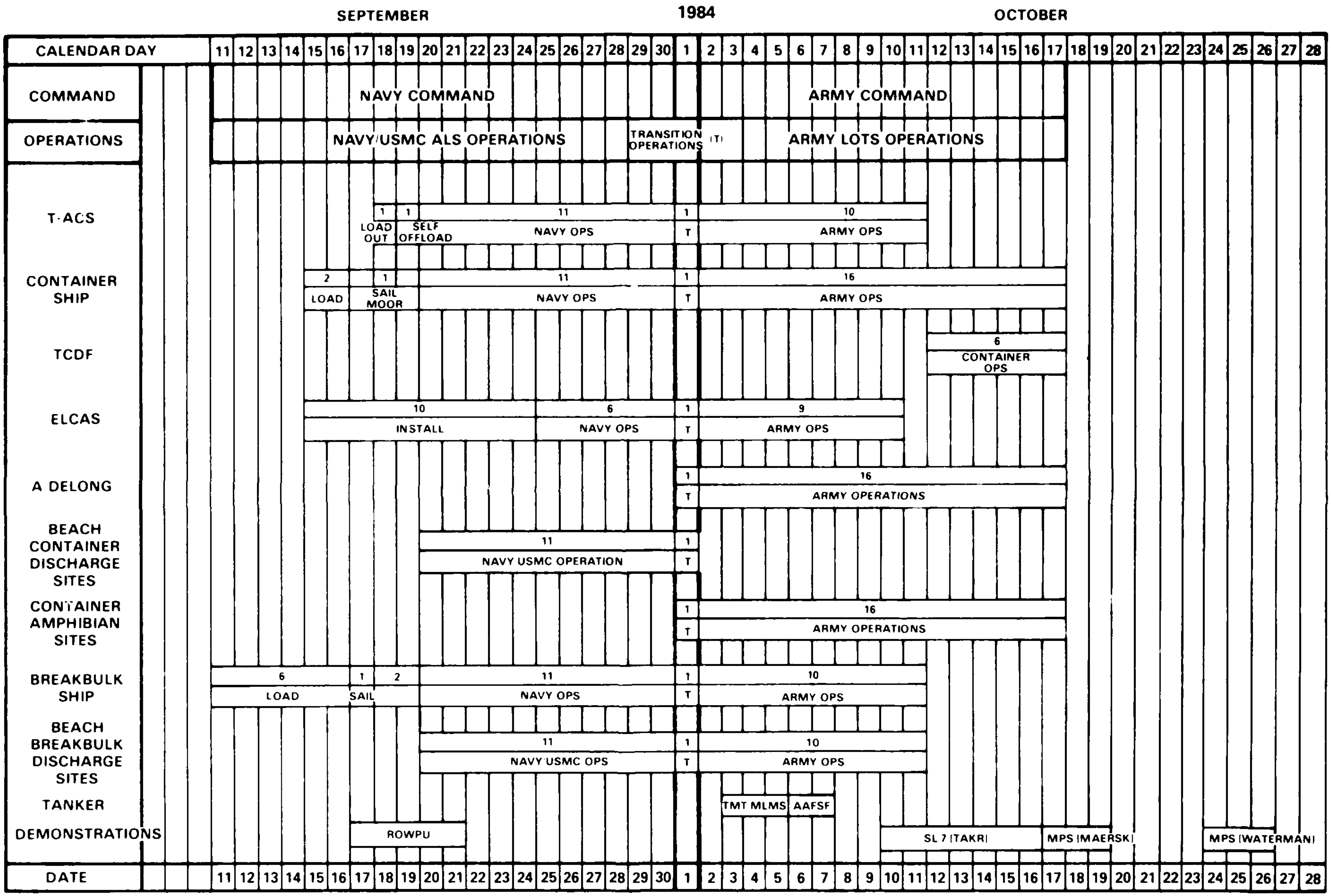


Figure 2-39 - JLOTS II Throughput Operations, Schedule of Events

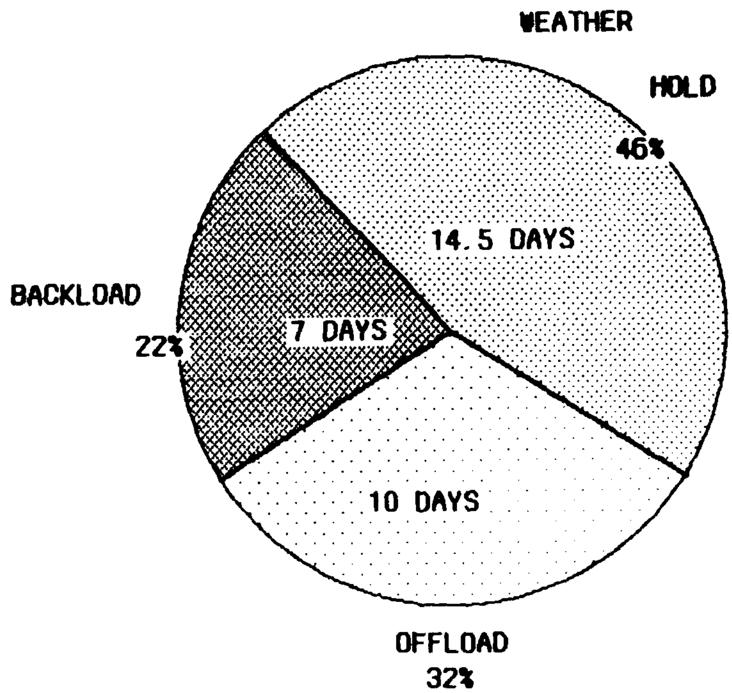


Figure 2-40 - JLOTS II Container Cargo Operations Summary

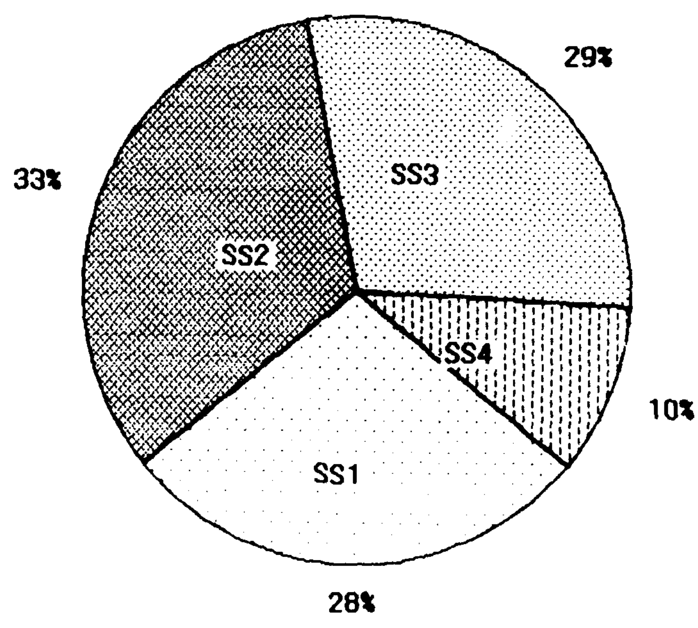


Figure 2-41 - JLOTS II Throughput Phase Sea State
Frequency of Occurrence

in the Individual Lighter performance section of this report. Detail characteristics of the lighters are in Sections 2.3.

2.5.3 Temporary Container Discharge Facility (TCDF)

The Army's barge TCDF was the second offshore container discharge system tested during the Throughput Test. Two TCDF's were employed during the test to offload both sides of the containership. The TCDF container offload operations took place 15-17 October after the Army completed the T-ACS operations. Figure 2-24 shows TCDF operations. Additional technical details on TCDF's is contained in Section 2.3.3.1.

2.5.4 Breakbulk Operations

The breakbulk ship used during the Throughput Test was the SS CAPE ANN assigned to the Ready Reserve Fleet. The SS CAPE ANN was loaded with 2,100 STons of palletized training cargo by Army units at a James River anchorage.

2.5.4.1 Navy/Marine Corps Breakbulk Operation

On 20 September 1984, offload operations commenced under the operational direction and control of Commander, Amphibious Squadron 4. Stevedore personnel were provided by the Naval Cargo Handling and Port Group (Augmented by USN Reserves). During the USN/USMC test period, 323 STons of palletized cargo were transferred ashore during an average 10-hr work shift. All of the palletized cargo was offloaded in 3-1/4 days.

2.5.4.2 Army Breakbulk Operation

When the Navy/Marine Corps portion of the Throughput Test was completed, the Army assumed control of discharge operations. Approximately 303 STons of palletized cargo were transferred ashore during an average 10-hr shift during the Army phase.

2.5.5 POL Operations

Previous tests of over-the-shore discharge systems have concentrated exclusively on dry cargo transfer. The ability to transfer bulk POL products had not been assessed in a joint environment, leaving many unanswered questions regarding individual service capabilities.

Specifically, the capability to moor modern tankers 25,000 DWT and larger; deployment of and interface with hoses and pipelines one mile or more in length; and the capability to receive, store, and transfer POL products in quantities of more than [illegible] million gal per day was questioned.

Service plans to field new POL systems prior to JLOTS II were delayed due to revised operational requirements, but an assessment of current capabilities was retained for the Throughput Test. Offshore POL systems tested during JLOTS II, as described in Section 2.3, included:

- Navy Amphibious Assault Fuel Supply Facility (AAFF).
- Army Tactical Marine Terminal (TMT) anchorage with 5,000 ft of six-in. steel submerged pipeline.

Shoreside systems included:

- One tank farm assembly of the Marine Corps Amphibious Assault Fuel System (AAFS).
- One module of the Army Tactical Petroleum Terminal (TPT).
- Two Army Bulk Fuel Tank Assemblies (BFTA).

2.5.5.1 Navy Amphibious Assault Fuel Supply Facility (AAFSF)

The Navy AAFSF was developed to shuttle limited amounts of POL products (440,000 gal/day) from a tanker anchored one to ten miles offshore. The system tested in JLOTS II consisted of three towable fuel bladders, type L-Dracones, which were filled with water at the tanker and then towed to a floating electric fuel pump which had been moored with 20,000 lb Propellant Embedded Anchors (PEA). The liquid was then vacated from the bladder and pumped through a six-in. floating rubber hose to the beach tank farm. The AAFSF transferred 169,000 gal of water to the beach during a 48-hr period on 6-8 October 1894.

2.5.5.2 USMC Amphibious Assault Fuel System (AAFS)

The Marine Corps AAFS was the intended receiving, storage, and distribution portion of the AAFSF employed on the shore. It consisted of one module of the AAFS consisting of six 20,000 gal fabric tanks and one 20,000 gal tank at a booster pump station. Unfortunately, the seven Marine Corps fabric tanks had to be removed prior to pumping operations because of extreme high tides and were later replaced with three 50,000 gal bladders which were borrowed from the Army and installed on higher ground.

2.5.5.3 Tactical Marine Terminal (TMT)

Six sub-systems of the Army TMT were programmed for installation during JLOTS II, including the TMT anchorage, six-inch floating hoseline, the six-inch submerged pipeline, the offshore drag embedment spread/moor anchorage, the shoreside Tactical Petroleum (TPT), and the Bulk Fuel Tank Assembly (BFTA). A single TPT module consisting of eight 50,000 gal bladders with their associated hardware, pumps, etc., was installed at the beach on 21 September in approximately 30 hr. Two 50,000 gal BFTA's were installed a total of four times as part of a Army evaluation. Each installation was accomplished in less than 1 hr.

2.5.6 Reverse Osmosis Water Purification Unit (ROWPU) Barge System

Configured for use as a potable water treatment and supply vessel, the ROWPU Barge System was designed to purify sea water and to transfer ashore 300,000 gal of potable water per day. The ROWPU Barge system demonstration, scheduled to start on 11 September, was postponed to 17 September because of bad weather. The actual demonstration was finally conducted at Fort Story from 17-23 September, 1984. During that period, the ROWPU Barge was installed and placed into operation twice. The Barge System operated for approximately 48 hr, which included about 24 hr of nighttime operations. The ROWPU Barge (Figure 2-35) demonstrated a production capability of approximately 225,000 GPD.

2.6 TEST DEMONSTRATIONS

In addition to the dry cargo and POL operations conducted during JLOTS II, there were demonstrations of a Modular Causeway System (MCS), and the offshore capabilities of the Fast Sealift Support ships (FSS) and Maritime Prepostioning Ships (MPS).

2.6.1 Modular Causeway System (MCS) Demonstration

The Flexifloat Modular Causeway System (MCS), consisted of twelve reinforced steel pontoons which were equipped with ISO container corner fittings. The assembled modular causeway had a draft of 1.5 ft, or six inches less than the Navy causeway system. The 40 ft by 8 ft by 4.5 ft pontoons were container-cell compatible and weighted about 22,400 lb. The 20-ft (19.875 ft by 8 ft by 4.5 ft) end pontoons had a 7 ft, 20 deg rake

and weighed about 11,500 lb. These end pontoons were not container-cell compatible because they were modified to incorporate the Navy causeway flexor and shear connectors which extended beyond the ISO corner fittings by 10.75 in. The 40-ft pontoons were stowed in 40-ft container cells on the T-ACS while the end pontoons were placed in SEASHEDS for stowage prior to their use.

Initially, the pontoons were joined on the hatch covers of the T-ACS as a half-platform (3 end pontoons plus, 3 center modules). While individual pontoons were positioned by a T-ACS crane using commercial hydraulic spreader bars, a half-module was lifted by a pair of T-ACS cranes using custom slings and corner lift fittings. The two half-modules (60-ft each) were connected together alongside T-ACS and then each end of the MCS was attached to a conventional causeway section forming a Causeway Ferry, designated as F5 which was 300-ft long. This ferry was used with the other Causeway Ferries to transport containers (Figure 2-42).

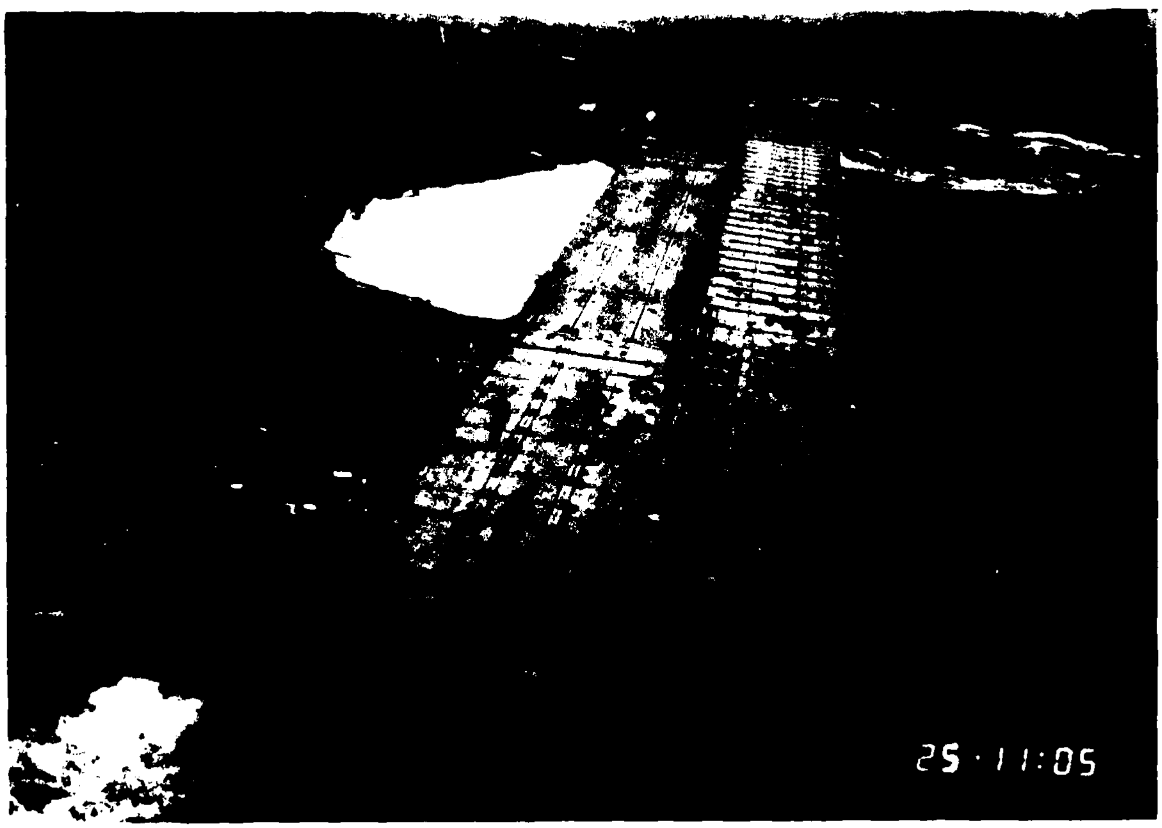


Figure 2-42 - Modular Causeway Section

2.6.2 T-AKR Demonstration

The T-AKR demonstration centered on the capabilities of the new Fast Sealift Support ships (FSS) to discharge cargo over-the-shore. The objectives were to demonstrate:

- In-stream marriage of the T-AKR RO/RO ramp to the Calm Water RO/RO Discharge Facility to permit discharge of military tracked and wheeled vehicles in a RO/RO operation.
- Mooring of lighterage to the T-AKR for Lift-On/Lift-Off (LO/LO operations.
- In-stream LO/LO of containers and military vehicles to lighterage.
- In-stream LO/LO of Army helicopters to lighterage.

The Fast Sealift Support Ship Program (T-AKR), was developed to provide ships capable of expeditious loading and unloading of military vehicles and equipment, including tanks and helicopters. The program is intended to enhance rapid deployment of military equipment and supplies located in the continental United States to potential objective areas throughout the world. The T-AKR program involved the procurement of eight SL-7 Class high-speed containerships and their subsequent conversion to a cargo configuration specifically designed for rapid load-offload of military unit equipment. The conversion design eliminated the midship container cells to permit Roll-On/Roll-Off of vehicles and supplies and retained the aft existing container cells with minor modifications. The USNS CAPELLA (Figure 2-43) was selected as the demonstration vessel for JLOTS II.

The USNS CAPELLA was loaded with demonstration cargo which included wheeled/tracked vehicles, helicopters, and MILVANS on 1 October. The offshore offload operations started on 10 October. The following is a brief summary of the T-AKR operations:

- 10 Oct - LO/LO 17 vehicles and 2 helicopters.
- 11 Oct - RO/RO 2 vehicles. The sea conditions worsened (Sea State 3) and operations were canceled
- 12-14 Oct - No operations because of rough seas.
- 15 Oct - LO/LO remaining helicopters.
- 16 Oct - RO/RO remaining wheeled and tracked vehicles including an

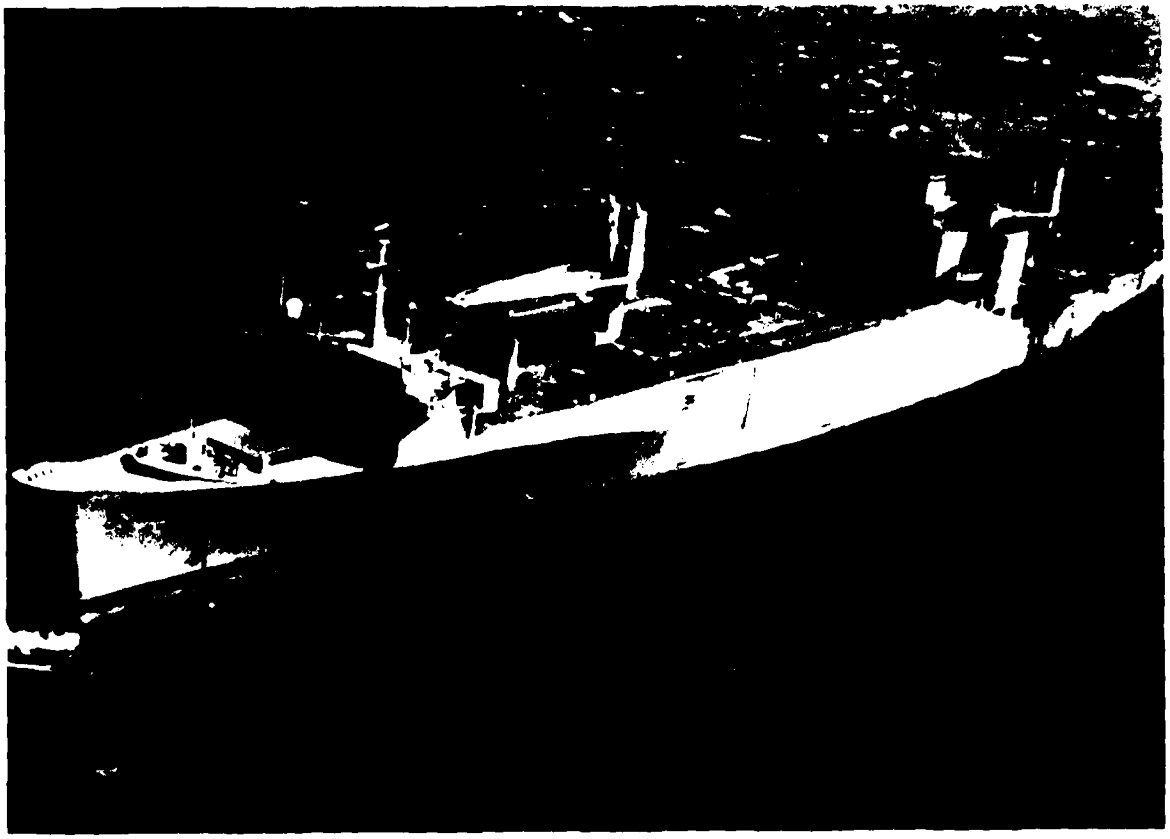


Figure 2-43 - USNS CAPELLA

M-1 tank onto the RO/RO discharge facility and then onto Causeway Ferries. RO/RO backload was also accomplished. Also LO/LO of vehicles from aft cargo holds.

2.6.3 Maritime Prepositioning Ships Demonstration

The Maritime Prepositioning Ship (MPS) demonstration was conducted with the lead ships of the MAERSK, WATERMAN, and AMSEA (ex. BRAINTREE) Classes. The American Overseas Corporation (AMSEA) demonstration was not a scheduled JLOTS II event. The purpose of the demonstration was to assess the operational capabilities of each vessel and obtain operational data on vessel performance during in-stream operations. The objectives were to demonstrate:

- LO/LO of lighters, vehicles, and containers.
- Amphibious Assault Vehicles splashing via stern ramps offshore.
- Spread moor anchorage for each class of ship.
- Discharge of potable water from ship-to-shore.

The MPS program was developed to position USMC equipment and supplies on board dedicated ships for prepositioning to overseas locations. The program is intended to provide lift, maintenance facilities, and controlled

environmental preservation for a balanced portion of the equipment, supplies, POL, and potable water to support a Marine Amphibious Brigade (MAB).

A total of 13 ships are in the MPS program; 5 in the MAERSK Class, 3 in the WATERMAN Class, and 5 in the AMSEA class. The MAERSK and WATERMAN Classes were converted from combination RO/RO ships. The AMSEA Class are new construction vessels. The Motor Vessels (MV) CPL LOUIS B HAUGE JR, SGT MATE J. KOCAK, and 2ND LT JOHN P. BOBO, lead ships of the MAERSK, WATERMAN, and AMSEA Classes, were selected for the JLOTS II demonstration.

MAERSK-1 MV CPL HAUGE. The MV CPL HAUGE (Figure 2-44) demonstration was conducted during the week of 15-20 October 1984. Prior to the ship's arrival at Fort Story, Virginia limited testing was conducted pierside at Norfolk, Virginia where all test vehicles were loaded aboard ship.

The demonstration included the following:

- Offshore offload of a LCM-8, a nonpowered causeway section, and SLWT using the ship's pedestal mounted cranes in the paired and tandem mode (4 booms).
- LO/LO of vehicles, and containers.
- Drive-off of two Assault Amphibian Vehicles (AAV) down the ship's stern ramp into the water.
- Setting of a three-point spread mooring, by the ship alone, and simulated tests of ship-to-shore pumping of POL and potable water.

WATERMAN-1 MV SGT KOCAK. The MV SGT KOCAK (Figure 2-45) demonstration was conducted during the week of 21-25 October 1984. Prior to the ship's arrival at Fort Story, pierside testing and loading was completed at Norfolk, Virginia. The demonstrations included the following:

- LO/LO of vehicles and containers.
- Drive-off of two AAV down the ship's stern ramp into the water.

The following were planned for the demonstrations but were cancelled:

- Offshore offload of a nonpowered causeway section and SLWT were cancelled because the cranes had insufficient lift capacity.
- Setting of a four-point moor using a SLWT (carried on board) to set stern anchors was cancelled, as was the planned ship-to-shore pumping operations. (The four-point moor was demonstrated in a later test.)

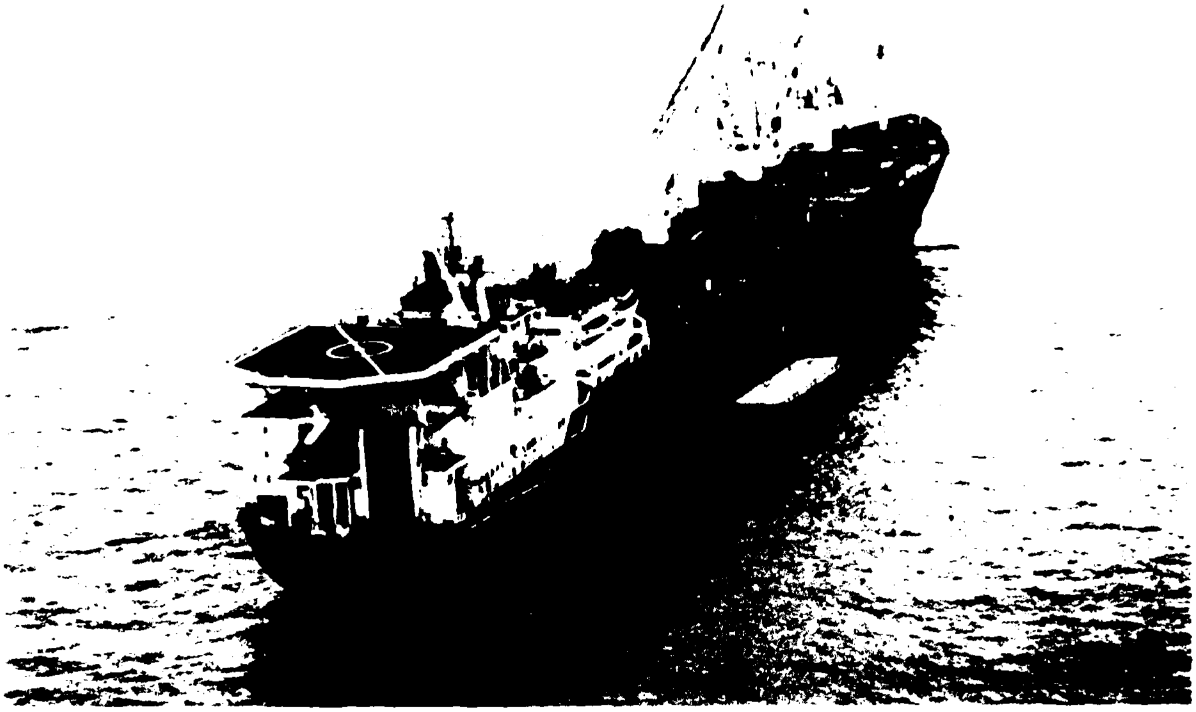


Figure 2-44 - MV CPL HAUGE

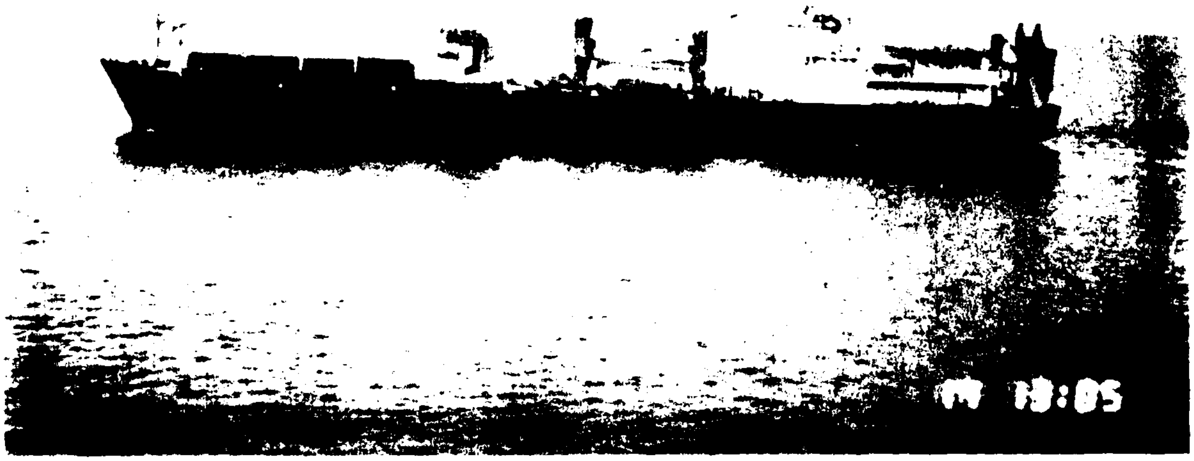


Figure 2-45 - MV SGT KOCAK

AMSEA-1 2ND LT JOHN J. BOBO. The MV 2ND LT JOHN P. BOBO (Figure 2-46) was conducted 11 March thru 15 March 1985. The demonstration included the following:

- Offshore onload and offload of the LCM-8 and a nonpowered causeway section. These lighters were positioned at various deck stowage locations to verify stowage adequacy. The planned lift of the SLWT was cancelled because of insufficient lift capacity within the cranes lifting hardware.
- LO/LO of vehicles and containers.
- Drive-off of seven amphibious vehicles (five LVTP-7, one LVTR-7, and one LARC-V) down the ship's stern ramp into the water.
- Setting of a four-point spread moor, by the ship alone, and simulated POL/water pumping test.

Figure 2-46 - MV 2ND LT JOHN P. BOBO

2.7 ENVIRONMENTAL AND MOTION SUMMARY DATA

During the period 20 September to 17 October 1984, instrumented environmental data was collected at the T-ACS, containership, and on shore. In addition, motions and accelerations of the T-ACS, containership, and selected lighters were also collected. The following is a summary of the data elements collected:

- T-ACS - Pitch, Roll, Vertical Acceleration, Heading
- Containership - Pitch, Roll, Vertical Acceleration, Barometric Pressure, Wind Speed and Direction, Temperature, Visability
- Lighters - Pitch, Roll, Vertical Acceleration (Sampled)
- Vicinity of T-ACS/Containership - Wave Height, Direction, Period, Current Speed and Direction
- Vicinity of Pier (Surf Zone) - Wave Height, Direction, Period, Current Speed and Direction
- Beach - Temperature, Wind Speed and Direction, Visibility, Barometric Pressure, Humidity

On an average, the above data elements were recorded about 16 times a day with each data sample period lasting about 10 min. This allowed for a record of the general environment and motions encountered through the entire test period. A summary of the data is provided in Figures 2-47 to to 2-52 and Tables 2-7 and 2-8 with special emphasis being given to those periods when the weather had an adverse effect on the tests. Sections 3, 4, and 5 of this report will discuss in detail weather related operational problems and delays with respect to specific test days. It is suggested that the reader utilize the following environmental and motion data to better understand the specific problem areas discussed in Sections 3, 4, and 5. Sea State is discussed in numerous places in this report. Sea States are defined in accordance with the Pierson-Moskowitz Sea Spectrum as summarized in Figure 2-52.

TABLE 2-7
TEST DATES - SEPTEMBER 1984

	Sep 20	Sep 21	Sep 22	Sep 23	Sep 24	Sep 25	Sep 26	Sep 27	Sep 28	Sep 29	Sep 30
Wind - Speed (kts)	1-8	2-9	8-19	8-18	6-17	2-16	9-44	17-33	16-29	19-29	12-28
Current - Speed, Max (kts)	1.3	1.9	1.4	1.8	2.4	2.2	2.6	-	-	-	-
Temp - Air (°F)	58-81	63-78	62-78	62-83	67-85	70-81	68-87	57-66	58-63	60-65	61-69
Offshore Waves - Direct.	E	NE	NE-E	E-NE	SW	SW	SW-NE	NE	NE	NE	NE
- Significant Hgt (ft)	1.5-2.0	0.2-1.9	1.4-2.6	1 -2.4	0.9-1.7	0.6-1.7	0.8-6.5	3.4-5.4	3.6-5.0	3.5-4.6	-
- Period (sec)	1.3-5.2	2.1-3.1	1.7-3.9	2.8-4.0	1.7-4.2	1.2-3.6	0.9-3.8	-	3.2-4.0	3.3-4.0	-
T-ACS Motion											
- Roll (deg)	0-1.6	0-0.4	0.0.3	0-0.4	0-0.2	0	0-0.3	0.2-0.6	-	-	-
- Pitch (deg)	0-0.3	0-0.2	0-0.3	0-0.2	0-0.8	0	0-0.3	0.1-0.3	-	-	-
- Vertical Accel.(g's)	0-0.01	0	0	0-0.01	0-0.01	0	0-0.01	0.01-0.02	-	-	-
Container Ship Motion											
- Roll (deg)	0-0.7	0-0.6	0-0.3	0-0.4	0-0.6	0	0-0.7	0.3-0.8	0.3-0.9	0.4-1.0	-
- Pitch (deg)	0-0.7	0-0.5	0-0.1	0-0.1	0-0.6	0	0-0.9	0.1-0.8	0.2-0.5	0.2-0.4	-
- Vertical Accel.(g's)	0-0.02	0-0.01	0-0.01	0-0.01	0-0.01	0-0.01	0-0.01	0.01-0.02	0.01-0.03	0.01-0.02	-
Lighter (P or U)* Motion	P1	P1	P1	P1	P1	P1	P1	-	U 1661	U 1661	-
- Roll (deg)	0.3-1.0	0-1.0	0.1-2.1	0-2.0	0-1.0	0-0.4	0-0.8	-	0.7-5.2	2.5-4.0	-
- Pitch (deg)	0.3-1.0	0-0.7	0.3-1.0	0-0.9	0-0.8	0-0.6	0-0.6	-	0.6-1.8	0.9-1.1	-
- Vertical Accel (g's)	0-0.03	0-0.03	0.01-0.04	0.01-0.04	0-0.02	0-0.02	0-0.03	-	0-0.10	0.07-0.09	-
Lighter (P or U)* Motion	U 1661	U 1661	U 1661	U 1661	U 1661	U 1661	U 1661	-	-	-	-
- Roll (deg)	0.4-1.3	0.4-1.4	0.6-1.9	0.4-3.6	0-1.5	0-0.2	0-7.3	-	-	-	-
- Pitch (deg)	0.3-0.7	0.3-0.5	0.4-1.0	0.4-1.0	0-0.6	0-0.2	0-1.8	-	-	-	-
- Vertical Accel (g's)	0-0.06	0.01-0.03	0.01-0.08	0-0.06	0-0.03	0-0.02	0-0.2	-	-	-	-

*P is for CSP+1; U is for LCU 1661

TABLE 2-8
TEST DATES - OCTOBER 1984

	Oct 1	Oct 2	Oct 3	Oct 4	Oct 5	Oct 6	Oct 7	Oct 8	Oct 9	Oct 10	Oct 11
Wind - Speed (kts)	3-35	15-31	14-20	7-17	7-19	11-24	13-26	4-13	1-10	6-27	16-28
Temp - Air (^{o}F)	54-66	54-64	48-73	56-78	54-74	62-67	55-74	52-72	55-73	58-73	63-71
Offshore Waves - Direct.	NE	NW	SW	N	E	NE	E	E	NE	NE	NE
- Significant Hgt (ft)	2.9-5.4	2.1-5.1	1.2-1.9	0.6-1.6	0.8-1.5	2.5-3.9	1.6-3.9	0.9-1.9	0.8-1.8	1-3.5	3.1-5.1
- Period (sec)	3.0-4.5	2.6-4.7	1.7-2.9	1.7-2.8	1.7-2.4	3.4-3.6	3.2-5.2	2.1-4.5	2.5-5.2	2.2-4.0	3.5-4.3
T-ACS Motion											
- Roll (deg)	0.2-0.5	0.2-0.4	0.1-0.3	0.1-0.3	0.1-0.3	0.1-0.6	0.2-0.5	0.1-0.3	0.2-0.4	0.2-0.4	-
- Pitch (deg)	0-0.3	0.2-0.3	0.2-0.3	0.1-0.4	0.2-0.4	0.1-0.5	0.1-0.7	0.1-0.3	0.2-0.6	0.1-0.5	-
- Vertical Accel.(g's)	0-0.01	0-0.01	0	0	0-0.01	0-0.01	0-0.01	0-0.01	0-0.01	0-0.01	-
Container Ship Motion											
- Roll (deg)	0.3-0.8	0.1-0.6	0.2-1.1	0.2-0.9	0.2-0.6	0.3-0.8	0.2-0.8	0.1-0.5	0.2-0.8	0.3-0.8	0.4-1.4
- Pitch (deg)	0.2-0.6	0.1-0.7	0.1-0.9	0.1-0.6	0.1-0.5	0-0.2	0-0.5	0-0.4	0.1-0.5	0.1-0.6	0.1-0.6
- Vertical Accel.(g's)	0.01-0.02	0-0.02	0	0	0-0.01	0-0.02	0-0.01	0-0.01	0-0.01	0-0.02	0-0.04
Lighter (U orV)* Motion	V-4	V-4	V-4	V-4	V-4	-	-	-	V-4 & 6	V-4 & 6	-
- Roll (deg)	0.1-3.4	0-3.8	0.6-1.7	0.6-4.6	0.2-2.9	-	-	-	0-2.8	0.7-1.1	-
- Pitch (deg)	0-2.7	0-2.2	0.4-2.8	0.3-2.7	0.1-2.5	-	-	-	0-2.2	0.4-0.8	-
- Vertical Accel (g's)	0-0.13	0-0.14	0.03-0.06	0.03-0.32	0-0.12	-	-	-	0.01-0.06	0.03-0.04	-
Lighter (U orV)* Motion	U 1661										
- Roll (deg)	0.7-4.2										
- Pitch (deg)	0.4-1.2										
- Vertical Accel (g's)	0.01-0.02										

*U is for LCU 1661; V is for LACV

TABLE 2-8 (cont)
TEST DATES - OCTOBER 1984

	Oct 12	Oct 13	Oct 14	Oct 15	Oct 16	Oct 17					
Wind - Speed (kts)	15-30	27-42	-	16-21	0-19	9-19					
Temp - Air (°F)	61-70	62-65	-	61-71	59-67	61-71					
Offshore Waves - Direct.	NE	N	-	E	NE	NE					
- Significant Hgt (ft)	3.1-4.9	4.1-7.8	-	2.9-4.1	2.1-3.1	2.4-2.7					
- Period (sec)	3.2-4.7	3.1-4.9	-	2.5-5.0	3.1-4.9	3.0-3.7					
TCDF Motion											
- Roll (deg)	-	-	-	-	0-1.1	0.2-2.1					
- Pitch (deg)	-	-	-	-	0-1.2	0.5-1.1					
- Vertical Accel.(g's)	-	-	-	-	0-0.03	0.01-0.03					
Container Ship Motion											
- Roll (deg)	0.4-2.6	1.0-3.3	-	0.5-2.4	0.4-2.2	0.3-2.1					
- Pitch (deg)	0.2-0.5	0.3-0.5	-	0.2-1.3	0.1-0.3	0.1-0.3					
- Vertical Accel.(g's)	0-0.04	0.01-0.04	-	0-0.01	0-0.01	0.01-0.02					
Lighter (V)* Motion	-	-	-	-	V-4	V-6					
- Roll (deg)	-	-	-	-	1.0	0.8-2.5					
- Pitch (deg)	-	-	-	-	0.6	1.9-5.0					
- Vertical Accel (g's)	-	-	-	-	0.035	0.06-0.10					

*V is for LACV

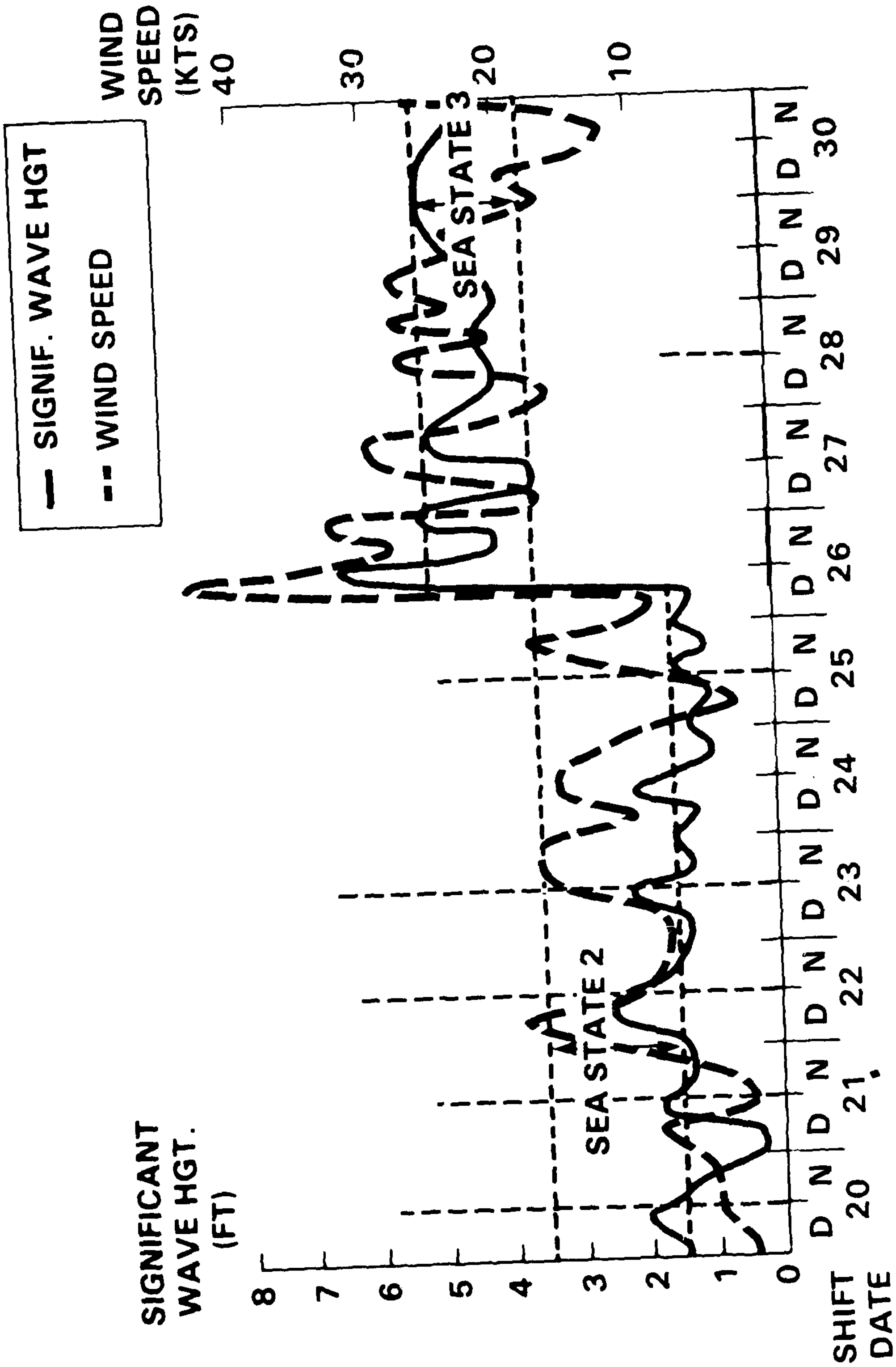


Figure 2-47 - Wave Heights and Wind Speeds during Navy Operations
September 1984

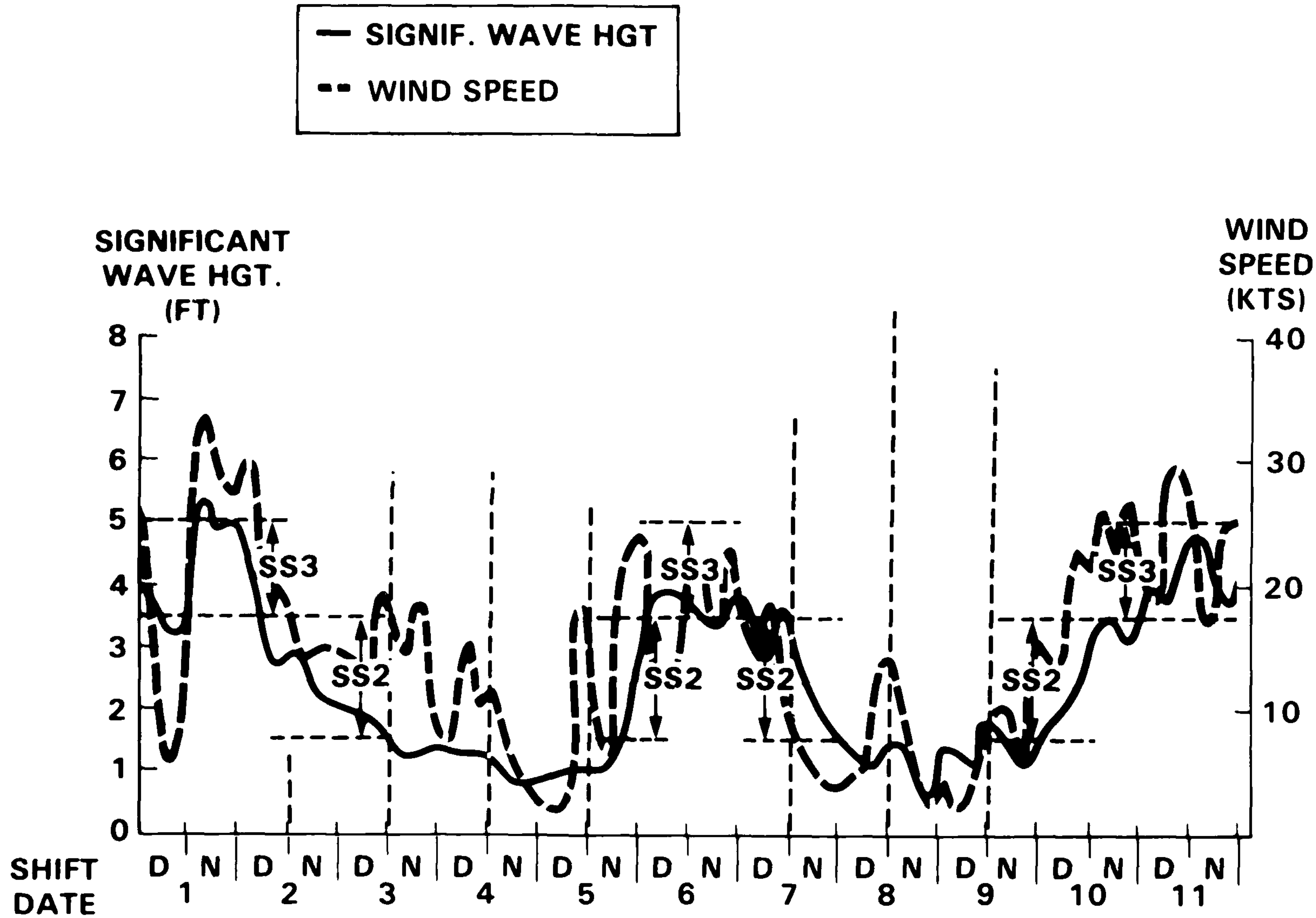


Figure 2-48 - Wave Heights and Wind Speeds during Army/TACS Operations
October 1984

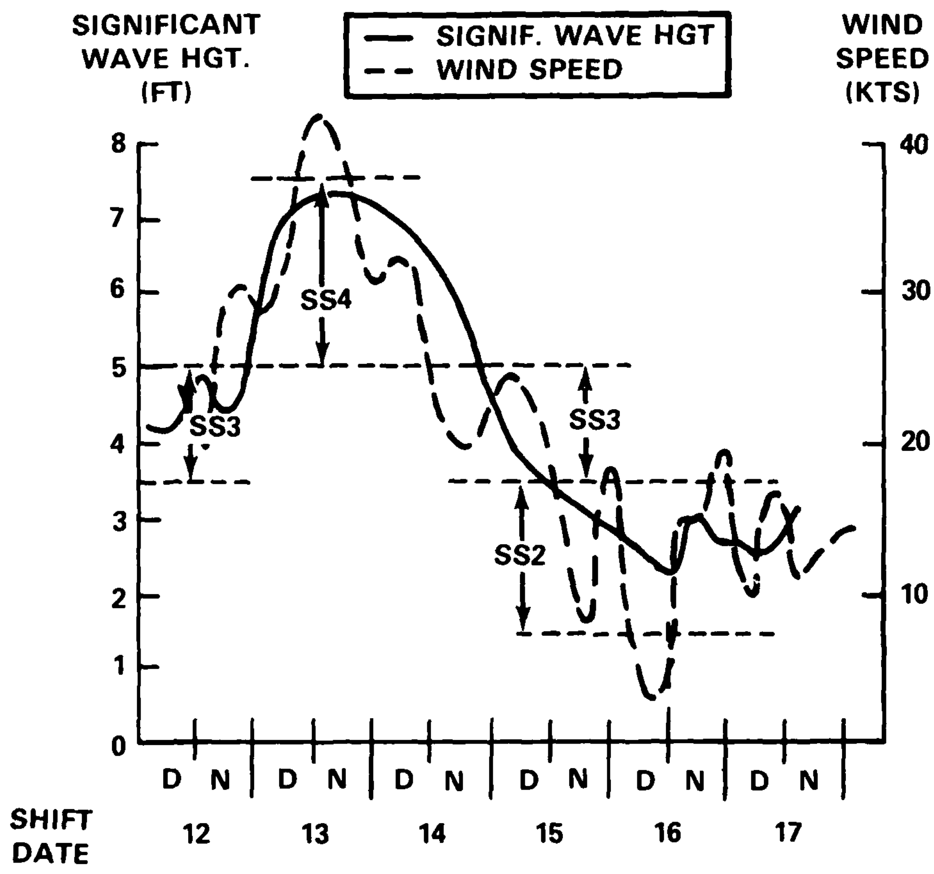


Figure 2-49 - Wave Heights and Wind Speeds during Army/TCDF Operations
October 1984

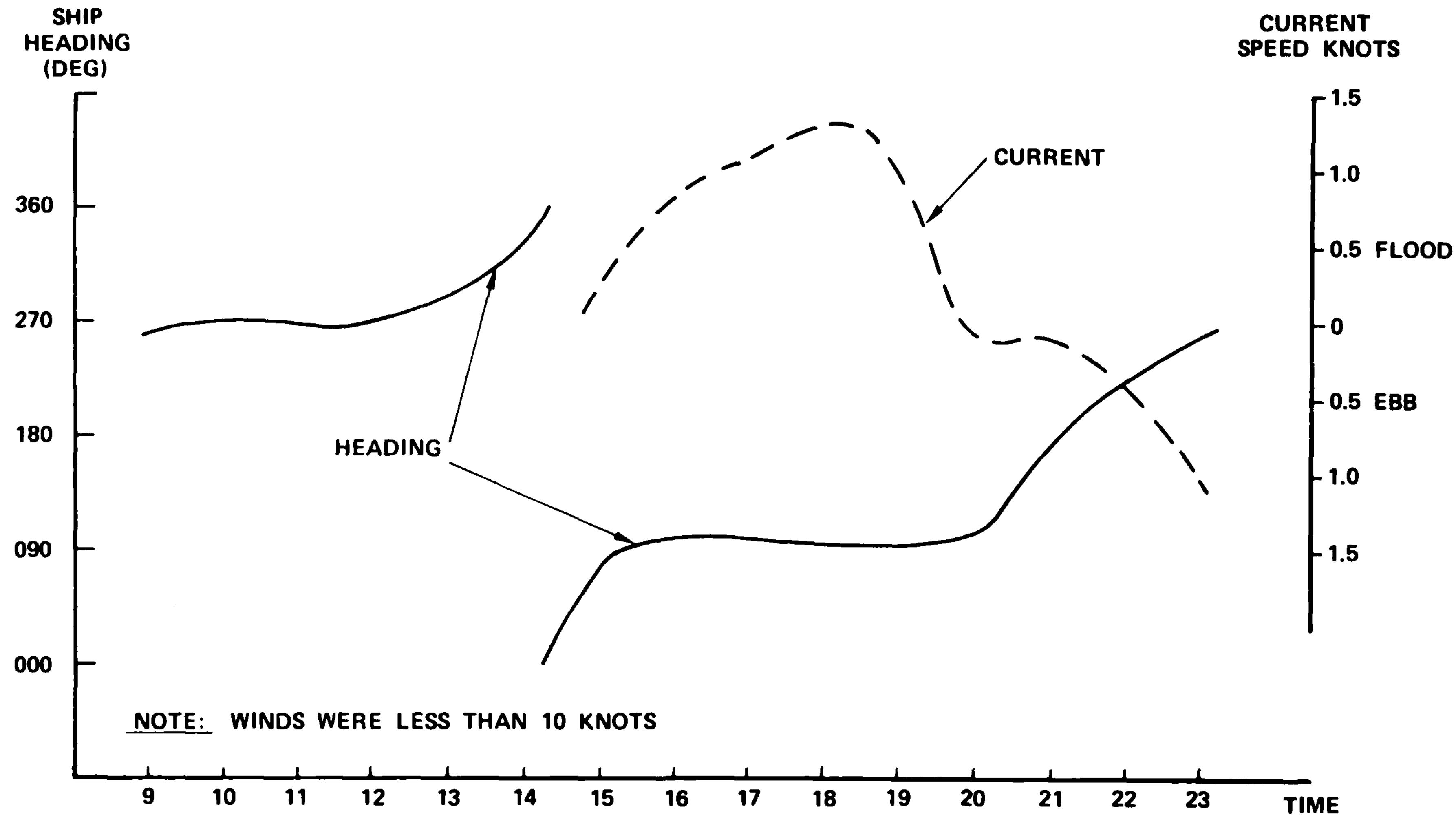


Figure 2-50 - T-ACS Heading and Current on 20 September 1984

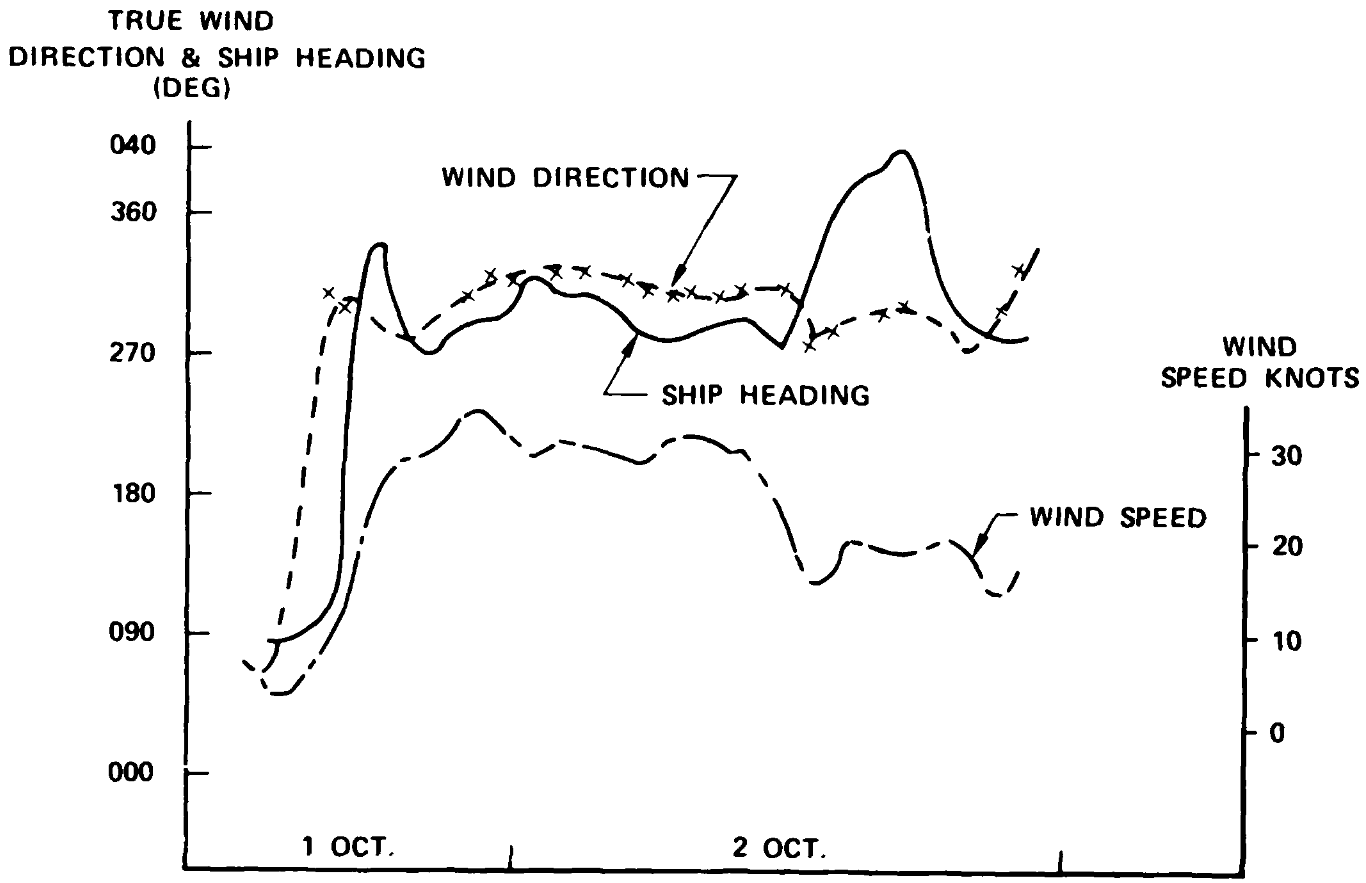


Figure 2-51 - T-ACS Heading, Wind Direction, and Speed, 1-3 October 1984

SEA STATE	SIGNIFICANT WAVE HEIGHT* (FT)	SIGNIFICANT WAVE PERIODS (SEC)	AVERAGE WAVE LENGTH (FT)
0	0.1—0.2	0.3—1.3	1.3—2.0
1	0.5—1.2	0.8—3.8	6.6—15.8
2	1.5—3.0	1.3—6.0	19.7—39.4
3	3.5—5.0	2.0—7.7	46.0—65.7
4	6.0—7.5	2.7—9.4	78.8—98.5

*SIGNIFICANT WAVE HEIGHT IS DEFINED AS THE AVERAGE VALUE OF THE HEIGHTS (WAVE CREST TO WAVE TROUGH) OF THE ONE-THIRD HIGHEST WAVES IN A GIVEN OBSERVATION.

Figure 2-52 - The Pierson-Moskowitz Sea Spectrum
(Sea States 0-4)

3.0 ANALYSIS, DISCUSSION, AND DETAILED CONCLUSIONS (Navy/Marine Corps)

This Section of the report covers the analysis of data collected during the period 11-30 September, 1984, the Navy/Marine Corps portion of the test.

3.1 INSTALLATION AND PREPARATION

JLOTS II Objective 2 is to assess the installation and preparation of over-the-shore systems and equipment for cargo operations. The Sub-objectives pertaining to Navy/Marine Corps systems address installation and preparation of the Auxiliary Crane Ship, Elevated Causeway, Amphibious Assault Fuel Supply Facility, Amphibious Assault Fuel System and the beach/marshalling areas.

3.1.1 Offshore Installation and Preparation

The installation and preparation of the offshore dry cargo systems consisted of the following:

- T-ACS anchoring, crane preparations, lighterage offload, and fender installations.
- Containership mooring to the anchored T-ACS by using commercial tug support.
- Breakbulk Ship anchoring and rig preparations.

3.1.1.1 T-ACS Preparation and Self-Offload

Preparation of the T-ACS-1 occurred on 14 and 15 September. This included unstowing the cranes, removing H-fenders and containership fenders from their below stowage locations, and installing the fenders. In addition, the rider blocks for the forward pedestal cranes (1A and 1B) were removed from stowage and installed. All of the other crane's rider blocks can be left on the cranes and therefore do not require special handling. The entire preparation was conducted by ship's force without military assistance. Most of the cranes were prepared simultaneously, enabling the preparations to be done in approximately 10 hr. Major elements of the preparation times are provided in Table 3-1.

A two-day weather delay occurred on 16 and 17 September. This weather resulted in some damage to several of the ship's padeyes which were used as

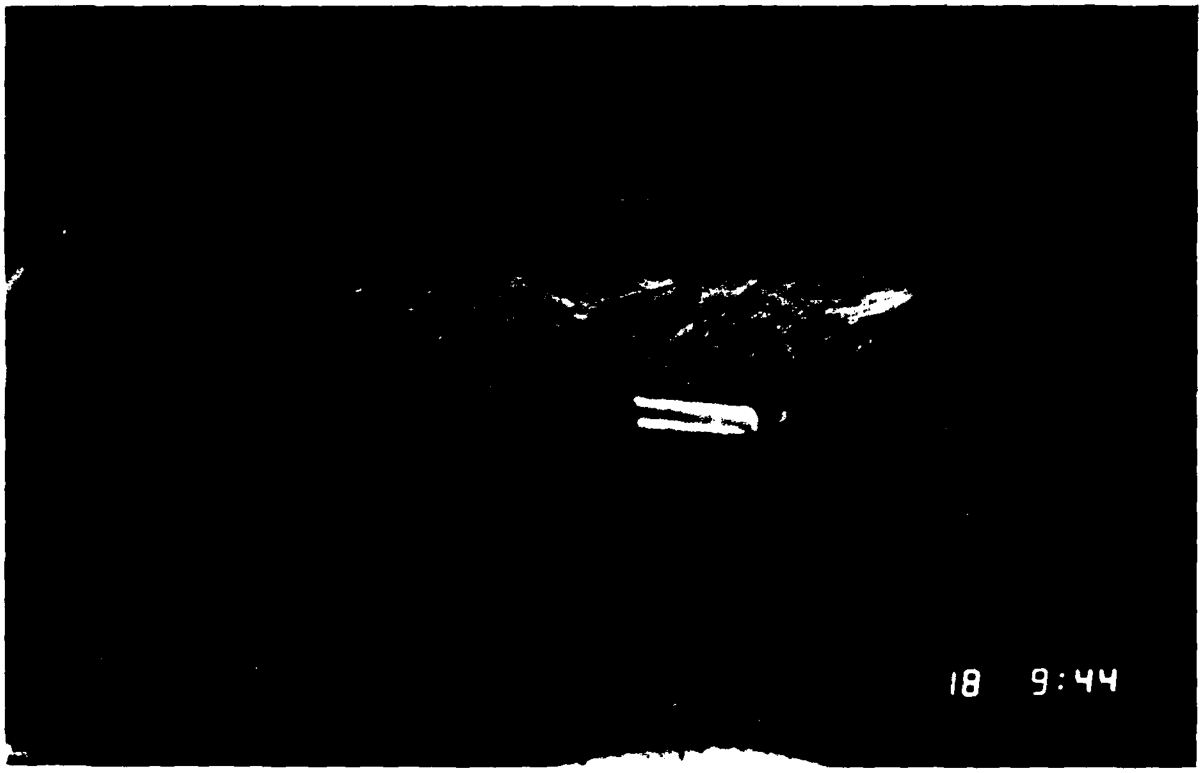
TABLE 3-1 - PREPARATION TIMES FOR T-ACS 1

Time to Accomplish Time	Event
1 Hr	Unstow/Raise Each Crane
1-1/2 Hr	Breakout Fenders
4-1/2 Hr	Replace Damaged Umbilical Cable*
2 Hr	Install 10 H-Fenders
4 Hr	Install Ship-to-Ship Fenders

*The umbilical cable providing power and control signals to the hook rotator and spreader bar on crane 2A had been damaged during the last previous boom stowing operation.

attachments for fender pendants. The T-ACS crew removed the 10-ft diameter fenders from alongside (Figure 3-1), until the seas calmed. As shown in Figure 3-1, they also built and installed much stronger and durable padeyes. The attachments for these fenders, should be redesigned to eliminate padeye failure and wire rope pendant chafing at the T-ACS deck edge. Chocks and bitts could be considered in lieu of padeyes and synthetic line outboard of the chocks in lieu of wire rope (this will allow for stretch and reduce the impact loads on the pendants and associated attachments). On 18 September the large fenders were reinstalled in approximately 1/2 hr (Figure 3-1). In addition, on 18 September an LCM-8 and the modular causeway were loaded onboard and, during the morning of 19 September, a nonpowered causeway section was loaded, all in preparation for the T-ACS self-offload test.

The SEASHEDS were used to carry fenders, rider blocks, rigging equipment, 20-ft modular causeway units, and other miscellaneous cargo. The SEASHEDS worked well with the floors being opened very quickly to gain access to lower sheds or ship decks (Figure 3-2). The only significant problem encountered was during the stowage operation of the 20-ft flexi-float modular causeway bow units on the evening of 18 September. The T-ACS



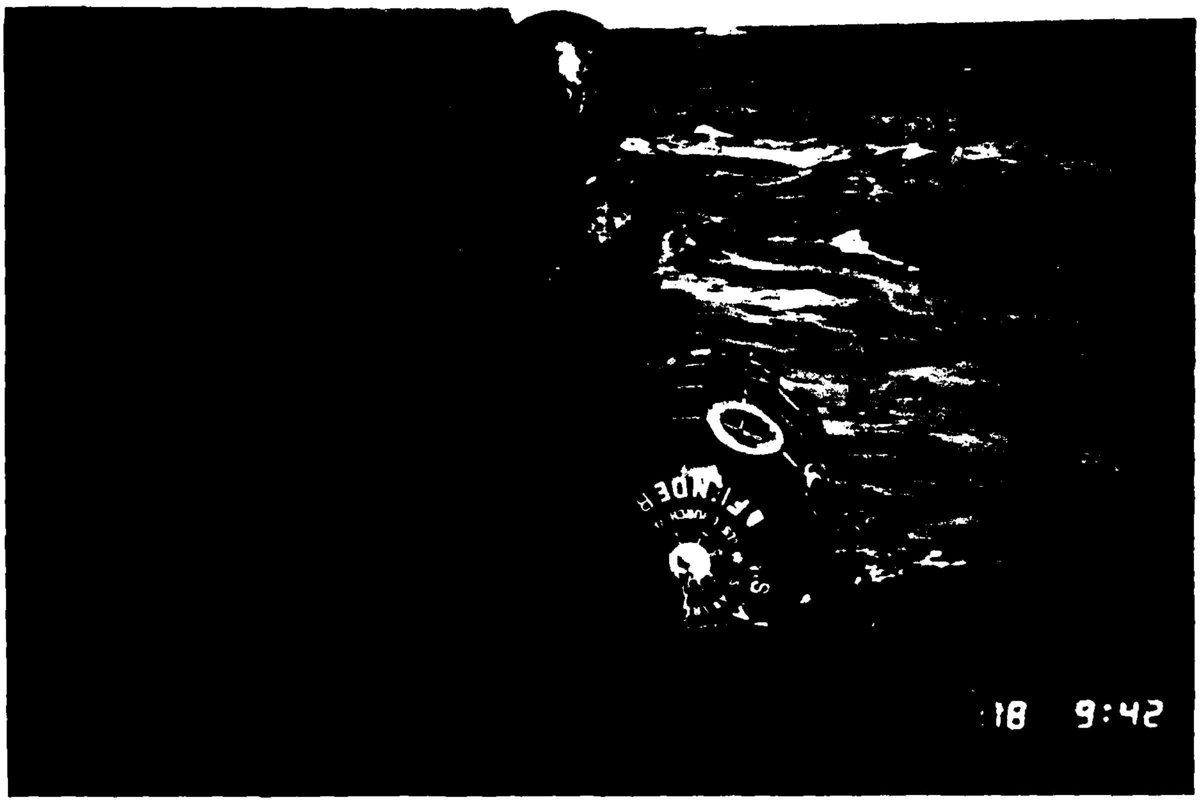
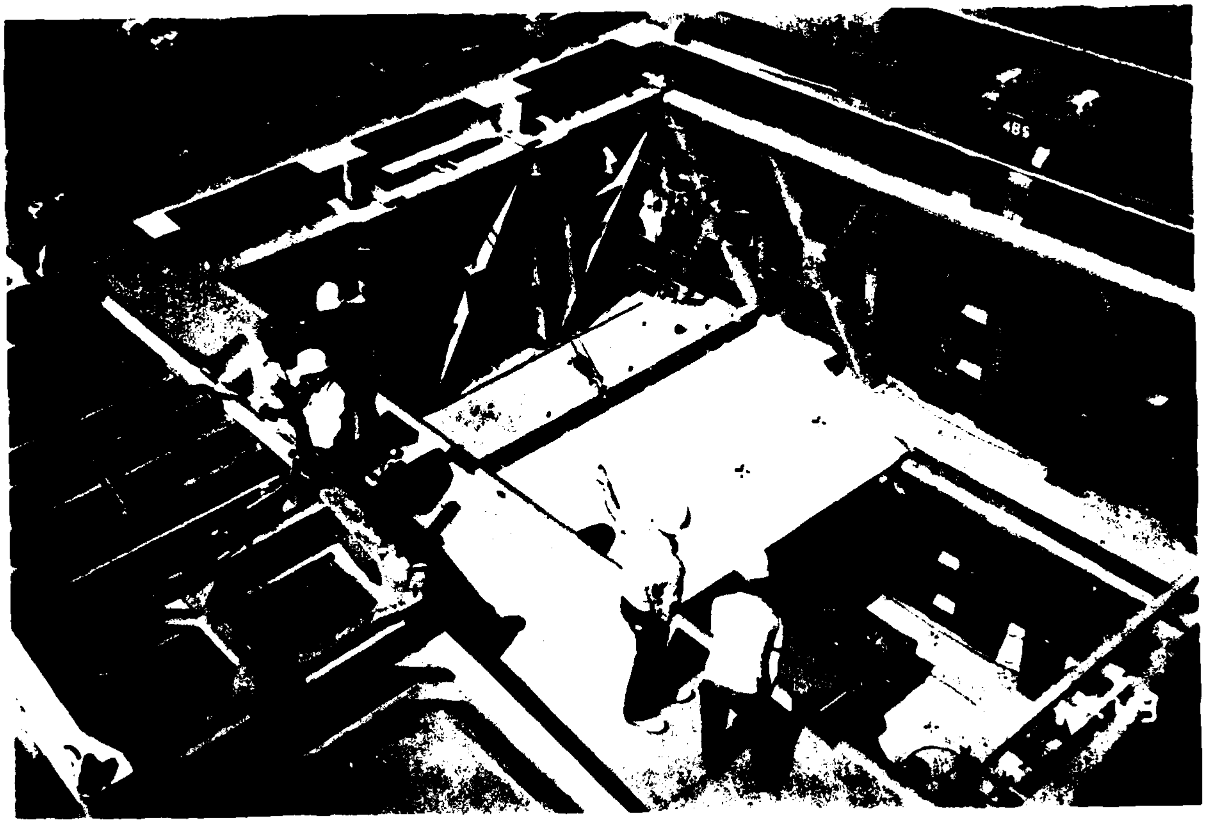


Figure 3-1 - T-ACS Ship-to-Ship Fendering System



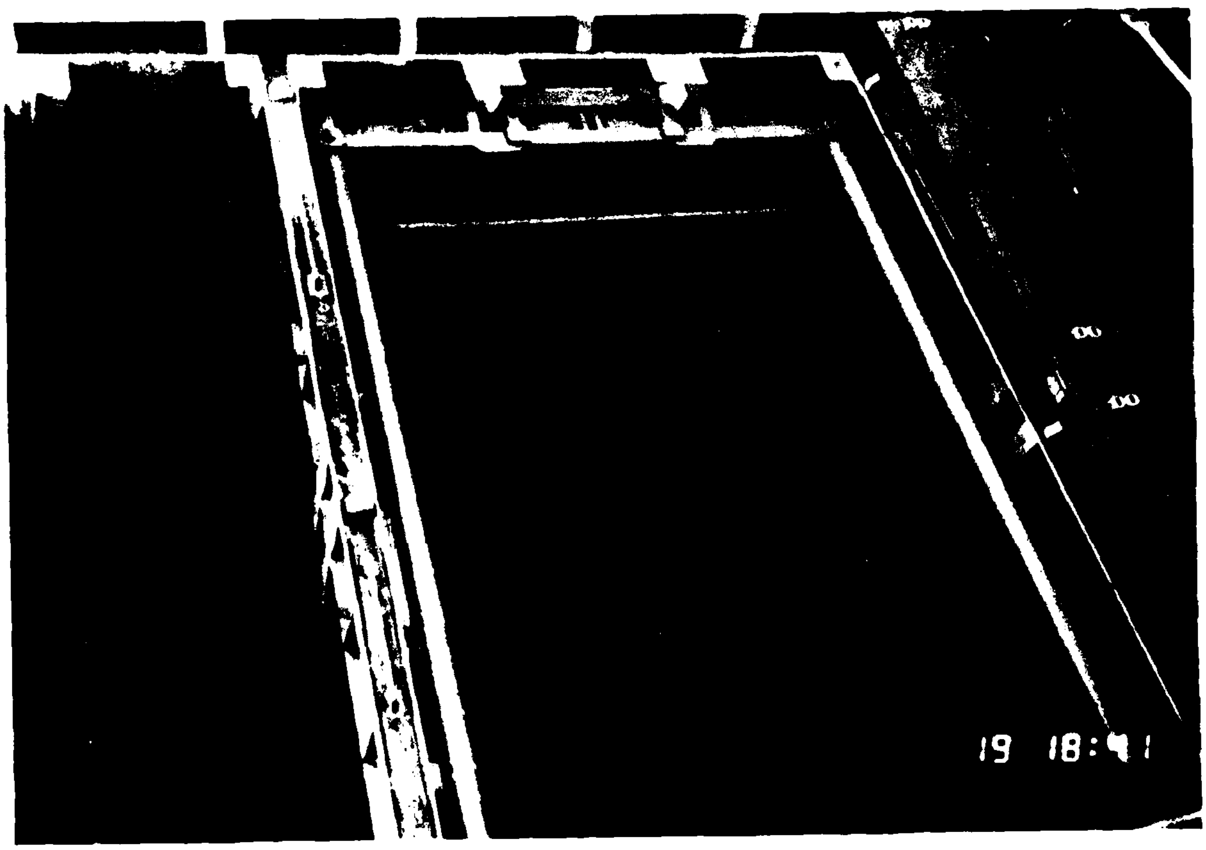


Figure 3-2 - SEASHEDS

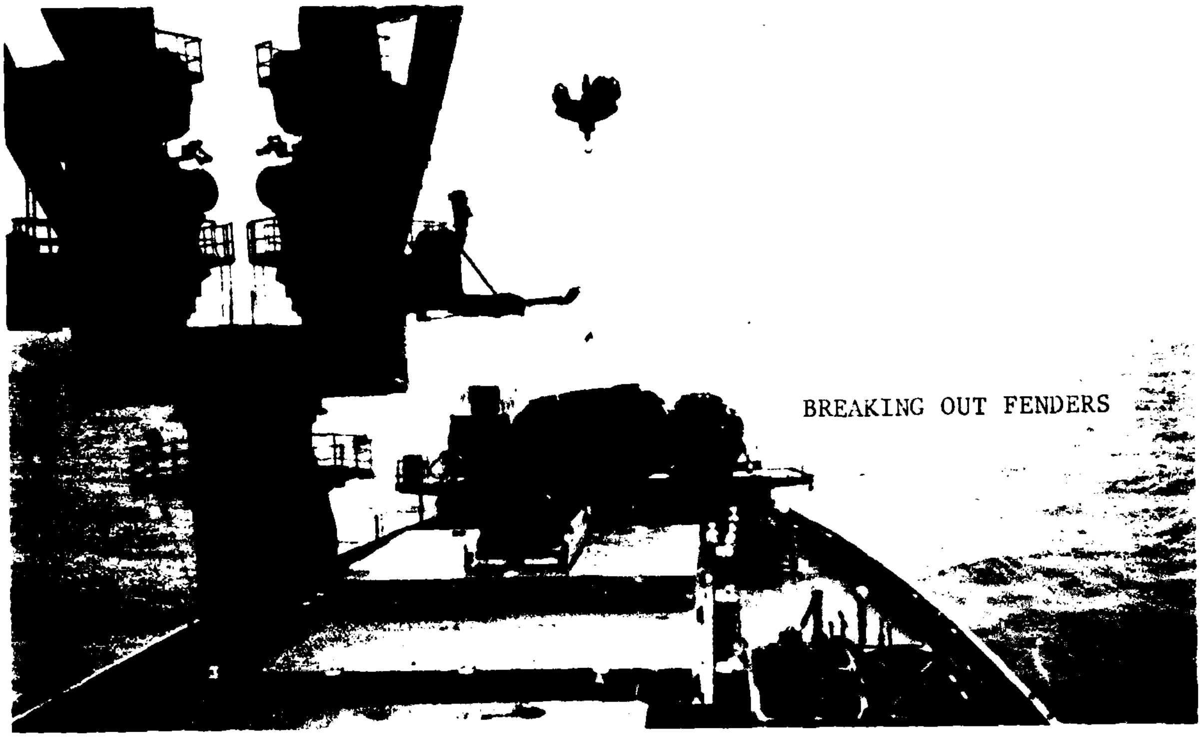
was heaving, pitching, and rolling slightly, which caused the T-ACS crane 2A hook to pendulate. The loads were pendulating by as much as 40-ft. This created safety hazards for the crew who were attempting to stop the pendulation by using taglines or, physically pushing against the swinging modules. Personnel in the SEASHED could have been injured by the swinging loads.

During most of the preparation and self-offload time the seas were rough and wind speed was high. As shown in Table 3-2, the wind generated seas and short period waves had little effect on ship motion, and there was no appreciable ship roll. However, as mentioned above, there were no pendulation problems were encountered on 18 and 19 September when small ship rolling occurred as a result of longer period waves and ground swells. Figures 3-3a and 3-3b shows the major elements of the T-ACS preparation.

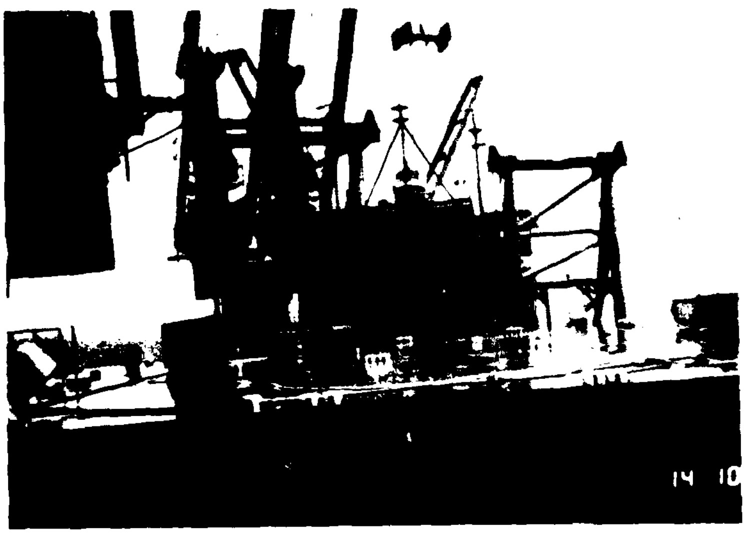
TABLE 3-2 - ENVIRONMENTAL CONDITIONS DURING T-ACS PREPARATION AND SELF-OFFLOAD

Date	Wind Direction	Wind Speed (knots)	Ship Roll (deg)	Sea State (observed)
9/14	E	8-15	0	3-4
9/15	N	8-24	0	3-4
9/18	NE	5-12	0	3-4
9/19	NNE	7-19	1/2 - 1	1-2

Figure 3-3 - T-ACS Preparation



BREAKING OUT FENDERS



RIGGING H-FENDERS

Figure 3-3 (cont) - T-ACS Preparation

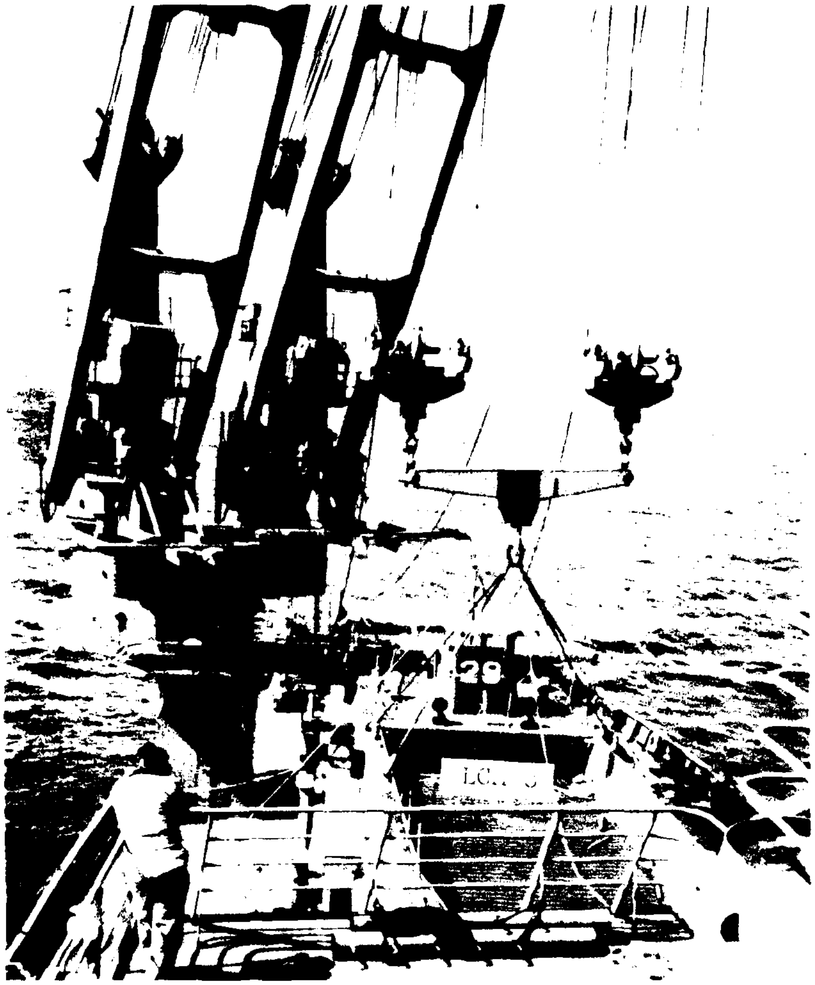
The T-ACS onloaded, carried, and offloaded 20-ft and 40-ft containers, outsized cargo stowed in SEASHEDS, an LCM-8, and a nonpowered causeway section. The T-ACS cranes can either be used singly in a twin crane arrangement, or in tandem (two sets of twin cranes). The load ratings for these configurations are (outreach measured from center of crane pedestal)[7]:

- Single Crane - 33 STons at 121-ft outreach (Designed to reach farthest container of alongside Panamax ship)
- Twin Crane - 65 STons at 85-ft outreach
- Tandem Crane - 95 STons at 96-ft outreach

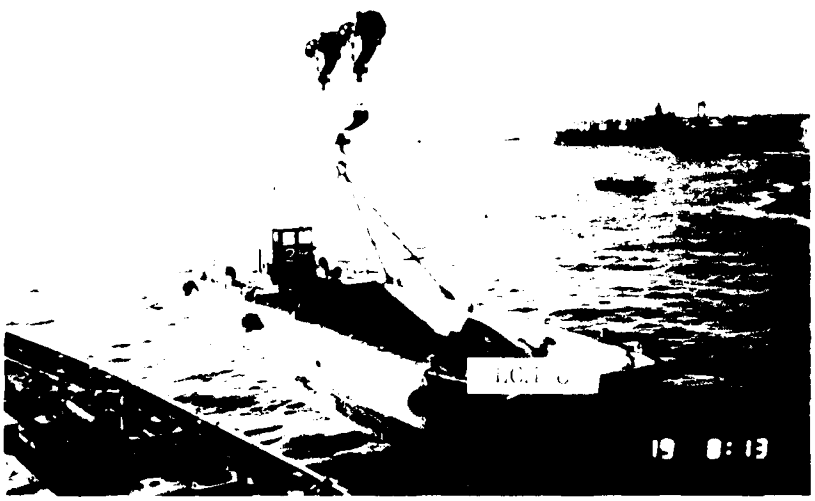
As shown in Figure 3-4, an LCM-8 and a nonpowered causeway section, carried as deck cargo, and 6 units of the modular causeway, carried in container cells and SEASHEDS, were self-offloaded on 19 September. The planned offload of a Causeway Section, Powered (CSP) was not accomplished. The LCM-8 was prepared for lift during loading operations in approximately 1 hr. Offload of the LCM-8, using cranes 3A and 3B at the aft pedestal, was accomplished in approximately 30 min. Offload of the nonpowered causeway section, including preparation time (i.e., equalizing beam installation time), was accomplished by cranes 1A and 1B and cranes 2A and 2B in approximately 2 hr. Offload of the 12 modular causeway units, preparation time, moving hatch covers, lifting on deck, joining sections, offloading 1/2 of the causeway at a time, and joining the 2 halves in the water was accomplished in approximately 9 hr.

Three significant problems occurred and are described as follows:

- On occasion, during periods when T-ACS was swinging with the tide change, she became exposed to small ground swells on her beam. This caused small ship rolls (approximately 1 deg) and created dangerous crane load pendulations. On one occasion pendulation caused the spreader to rotate, tearing out the umbilical power cable to crane 2A.
- The Rider Block Tagline System (RBTS) cannot be used while the cranes are in twin mode or tandem mode. This is a serious design deficiency which limits lighterage offload operations to calm sea conditions where there is no T-ACS roll.
- The CSP could not be lifted as its weight exceeded the 95-ton tandem crane lift capacity.

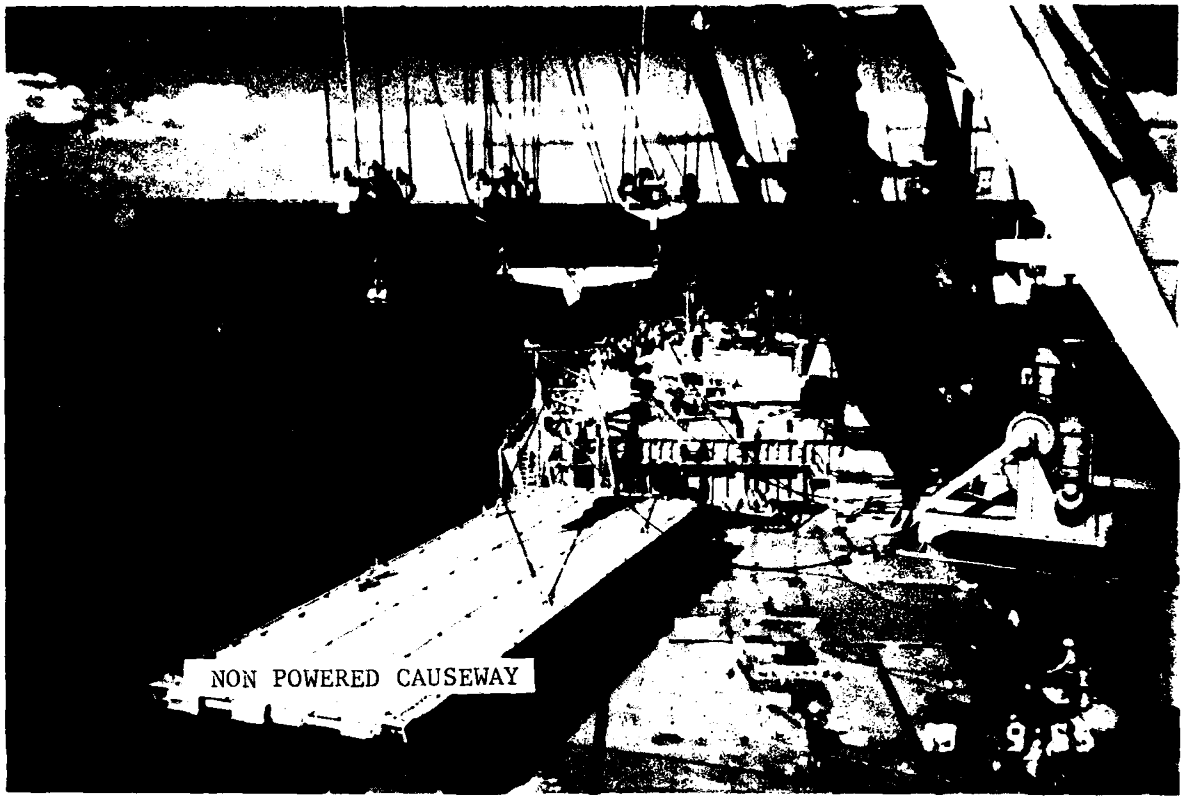


(a) LCM-8

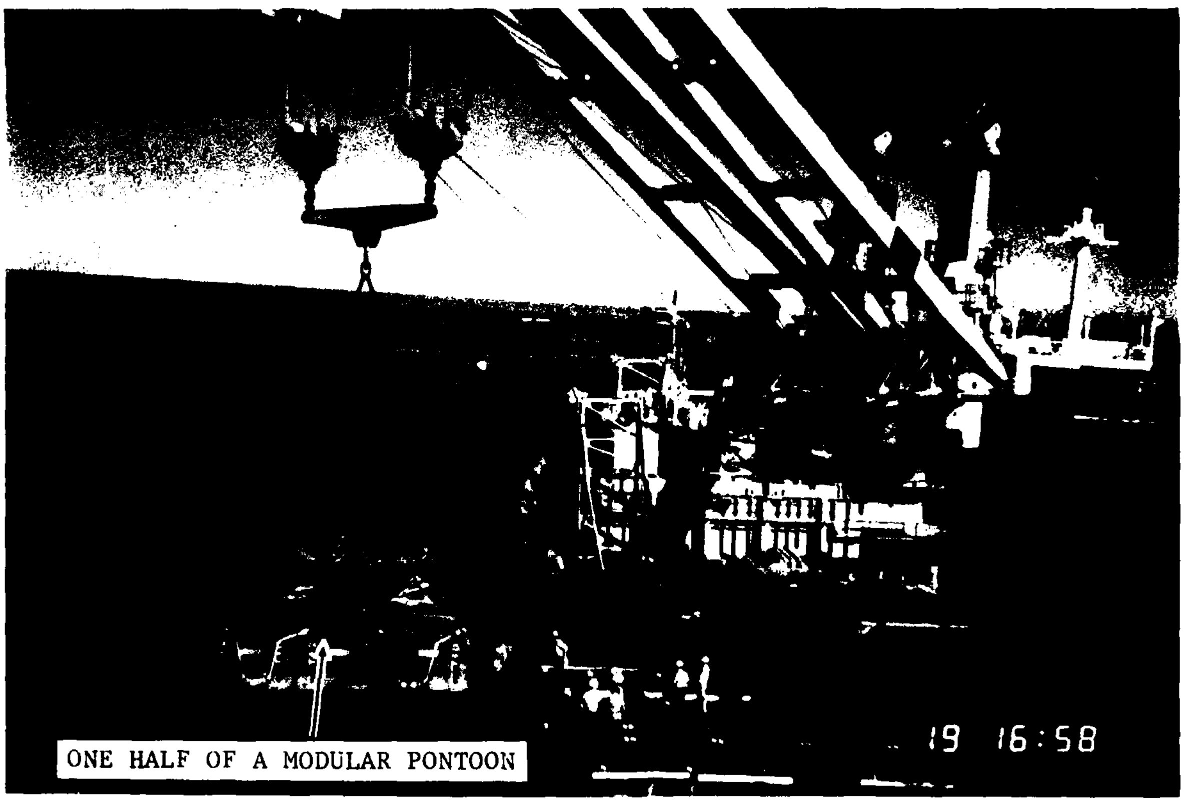


(b) LCM-8

Figure 3-4 - T-ACS Offload of Lighters



(c) Nonpowered Causeway Section



(d) One-Half of a Modular Pontoon

Figure 3-4 - T-ACS Offload of Lighters

Subsequent to the test the CSP weight was determined to be 205,000 lb. The T-ACS-1 cranes should be re-certified for this load. Additionally, the cranes may require redesign in order to accommodate the differential weight distribution between the booms. If a redesign is required, the weight of a Side-Loadable Warping Tug (SLWT) rather than a CSP should be the target lift. In addition, a safety factor of up to 10% should be included to account for the weight of water in damaged pontoon cans.

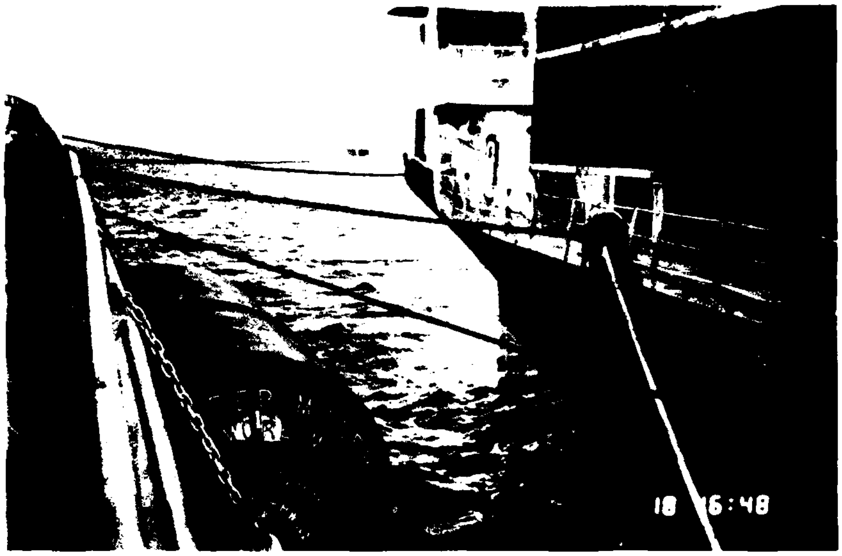
A load indicator system should also be installed on the cranes. This would permit the crane operator to determine actual lift weight.

3.1.1.2 T-ACS/Containership Mooring

Two commercial tugs moved the EXPORT LEADER alongside T-ACS-1 on 18 September. As shown in Figure 3-5, the crews from both vessels installed mooring lines. The entire mooring operation was completed in 2 hr. It should be noted that the Operational Requirement (OR) for the T-ACS does not fully address the requirements for mooring containerships to the T-ACS. A capability to moor two ships with civilian tug assistance was demonstrated on 18 September, and by extension, could be assumed for similar military tugs. It would appear, however, that most Navy/USMC AFOE scenarios would not include tugs to provide assistance in mooring the ships. This was discussed at length during the planning for JLOTS II and it was determined that the ships should moor while underway or at anchor without tug assistance. This mooring was not accomplished[4] during the test for the following reasons:

- Reluctance on the part of the masters of the two ships involved due to responsibility and liability considerations.
- Interface considerations due to hull configuration of the T-ACS-1 KEYSTONE STATE and the USNS CAPELLA. This ship was chosen for the mooring test because of its availability in the area.
- Weather and sea state were not expected to be ideal on the days scheduled for the mooring test.
- Concern was expressed by local Coast Guard and Pilot Association officials regarding overall safety aspects of such a mooring.

The overhang of the bridge wings, as shown in Figure 3-5 of the T-ACS-1 and the numerous variations in hull configuration of containerships requires a careful review of the requirements and capabilities for



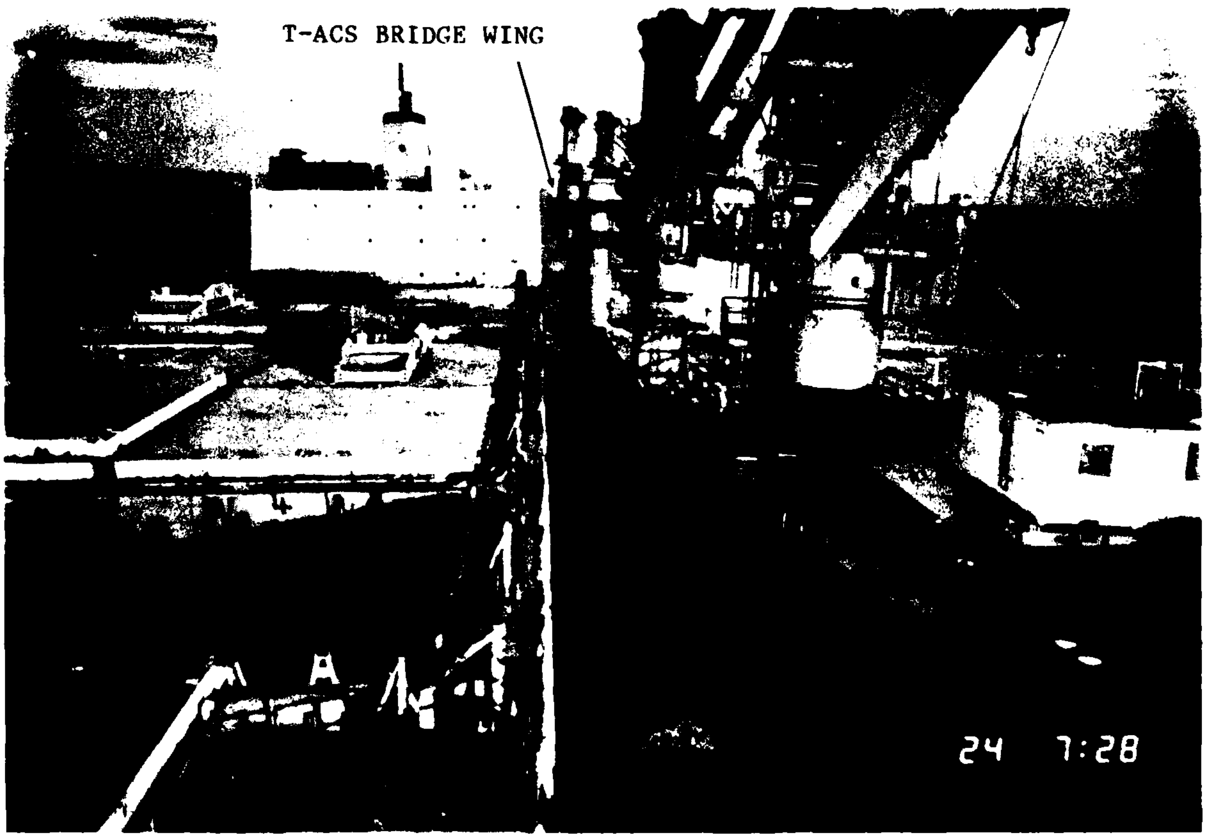
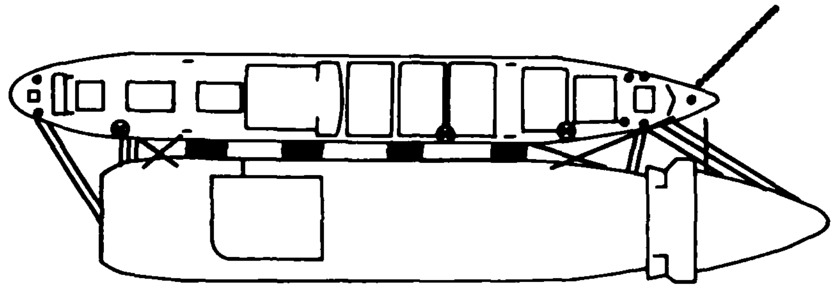


Figure 3-5 - T-ACS/EXPORT LEADER Mooring

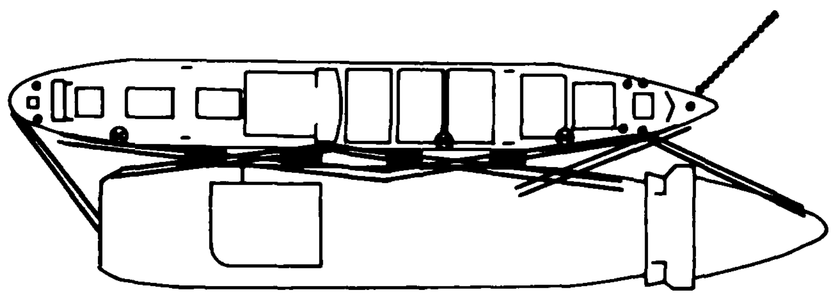
mooring these ships without tugs. Once this action is complete, mooring operations should be tested without tug assistance in a Sea State 3 environment.

Once moored, the T-ACS anchoring system with a single 13,200-lb balanced fluke anchor held both the T-ACS and the containership without incident. Additional mooring points should be added to the T-ACS, however, to assist in securing the two ships and to reduce mooring line chaffing problems. The arrangement used consisted of a large number of very short breast lines. These short breast lines stretched a great deal and acted as springs between the two vessels and actually tended to increase the relative motion encountered between the vessels. These short 8-in double braid nylon and polypropylene breast lines should be replaced with very long spring lines which carry the principal mooring load. In addition, the mooring lines provided to T-ACS-1 were only 300-ft long. They should be much longer to allow for longer length spring lines and to allow for doubling up on the same line. A preferred mooring arrangement shown in Figure 3-6 should be used as guidance in the development of an improved mooring arrangement plan which should become an established/documented procedure which doesn't rely on the ship's deck force to "improvise".

The 10-ft ship-to-ship alongside fendering system performed adequately with the exception of the fender attachment padeyes and wire rope chafing problems, discussed in Section 3.1.1.1. The 14-ft 6-in. diameter by 52-ft long low pressure pneumatic fenders were not used during the test. Future tests should use these fenders to verify their adequacy under Sea State 3 conditions and to confirm the adequacy of a 14-ft 6-in. standoff distance in preventing T-ACS/containership contact when long period ground swells cause the ships to roll toward each other.



ACTUAL MOORING ARRANGEMENT



PREFERRED MOORING ARRANGEMENT

Figure 3-6 - T-ACS/EXPORT LEADER Mooring Line Arrangement

3.1.1.3 Breakbulk Ship Preparation

The SS CAPE ANN was activated from the Ready Reserve Force and loaded out with dummy palletized cargo. On 17 September 1984, the ship anchored off of Fort Story, Virginia. A number of equipment problems occurred as a result of the ship's poor material condition and lack of stored rigging gear. As an example, a large wooden frame was constructed to serve as a fender for craft at the accommodation ladders. The problems are described in Section 3.2.2 of this report which deals with the actual operations. Once onboard, the stevedore personnel (active and reserves) from the Naval Cargo Handling and Port Group quickly and efficiently activated the cargo booms, opened hatches, and readied the vessel for offload operations.

3.1.2 Onshore Installation and Preparation

The installation and preparation of the onshore dry cargo systems consisted of the following:

- Beach preparation and maintenance
- Elevated Causeway installation
- RTCH and LACH cargo site preparation
- Marshalling area preparation

3.1.2.1 Beach Preparation and Maintenance

General. The preparation, layout, and installation of the beach roadway as shown in Figure 3-7 was initiated on 10 August 1984. The roadway material was a combination of the Army's new Sand Grid System (a plastic egg crate configuration) and the more conventional MOMAT (a dimpled, rough coated, fiberglass sheet). Figures 3-8 and 3-9 show these materials. The Sand Grid was used as the primary for roadway for transiting wheeled vehicles. Since Sand Grid does not stand up to heavy turning/maneuvering loads or to traffic across its shoulders, MOMAT was used in areas such as truck loading mats and as a transition from Sand Grid to the ELCAS. MOMAT is portable, i.e., can be rolled up and relocated. Sand Grid is not. Neither material performs well when used by tracked vehicles, particularly steel-cleated dozer tracks.

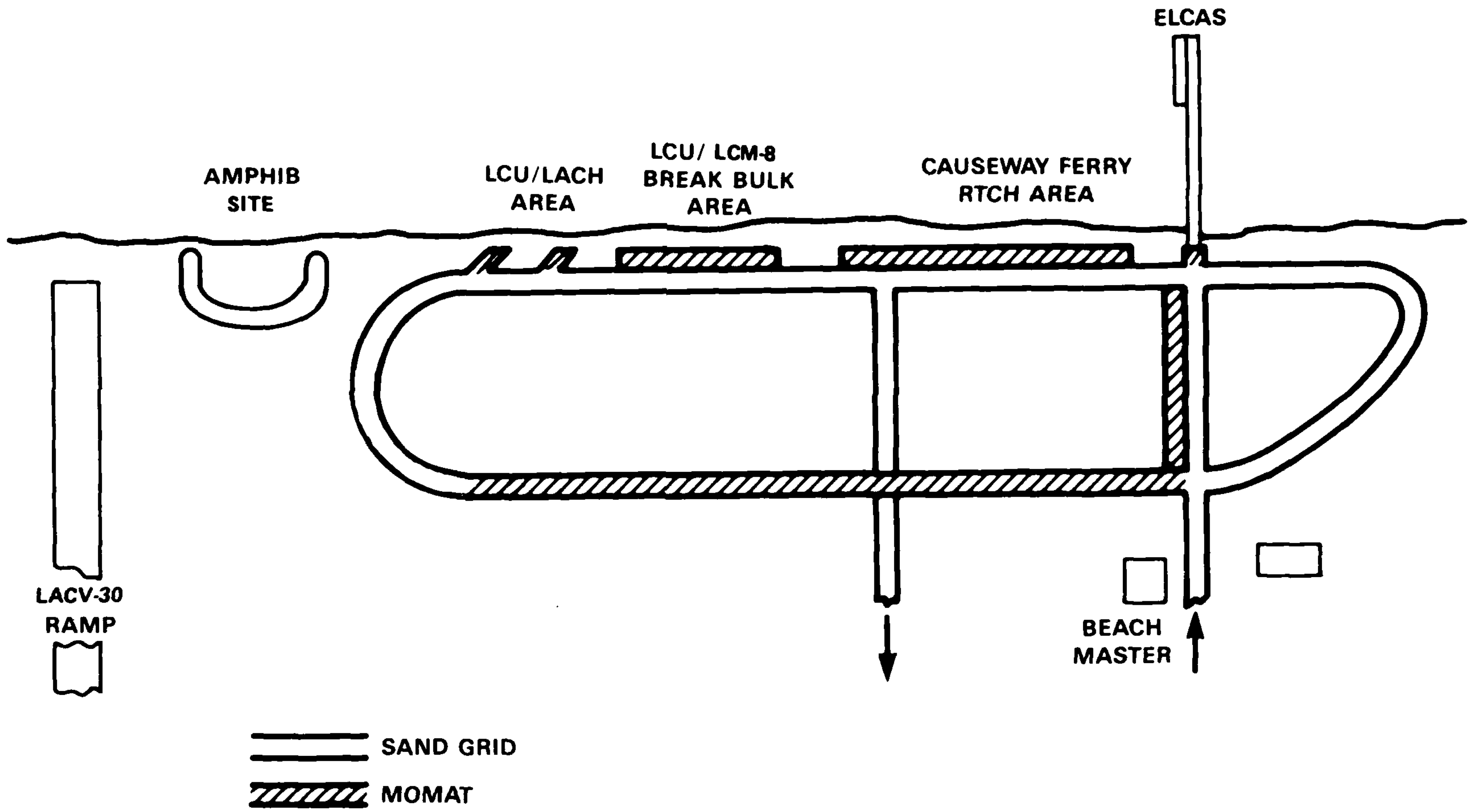
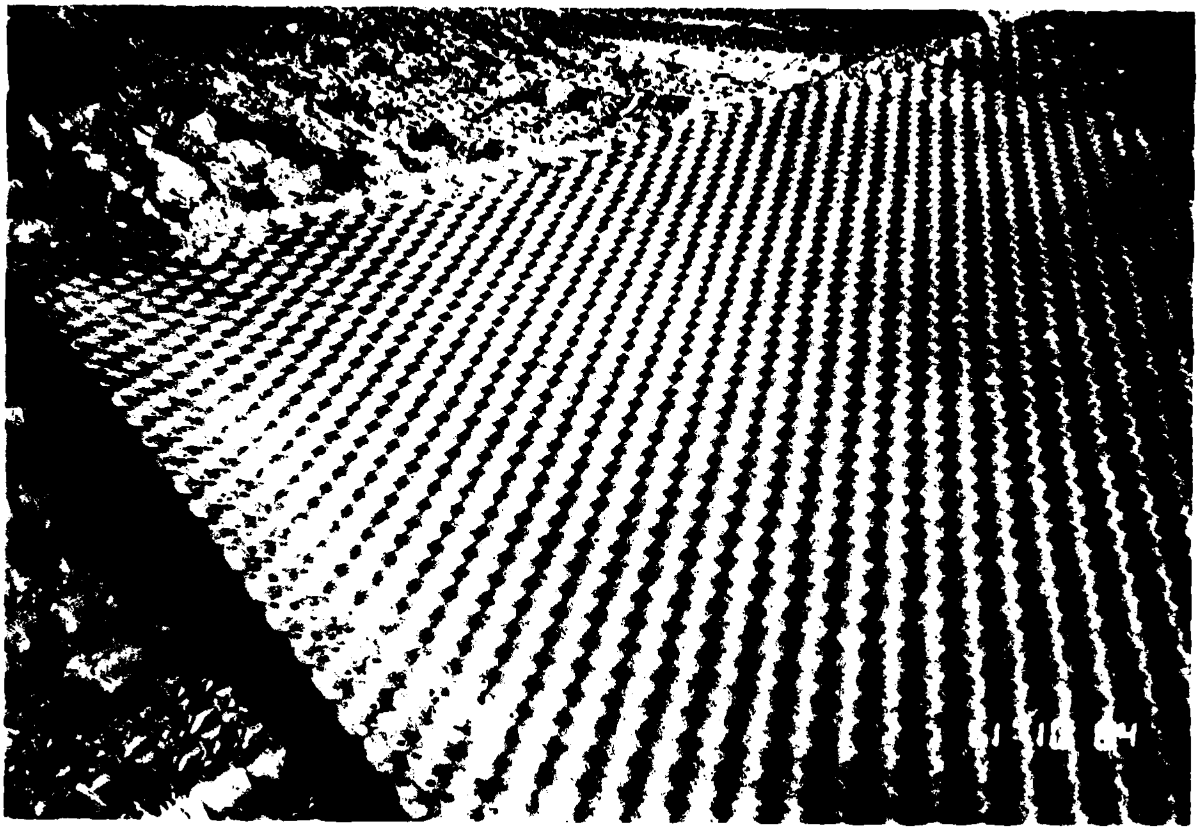


Figure 3-7 - Beach Layout - Navy/Marine Corps Test

Figure 3-8 - MOMAT Roll (Top) and Sand Grid (Center) Before Installation



MOMAT Being Installed

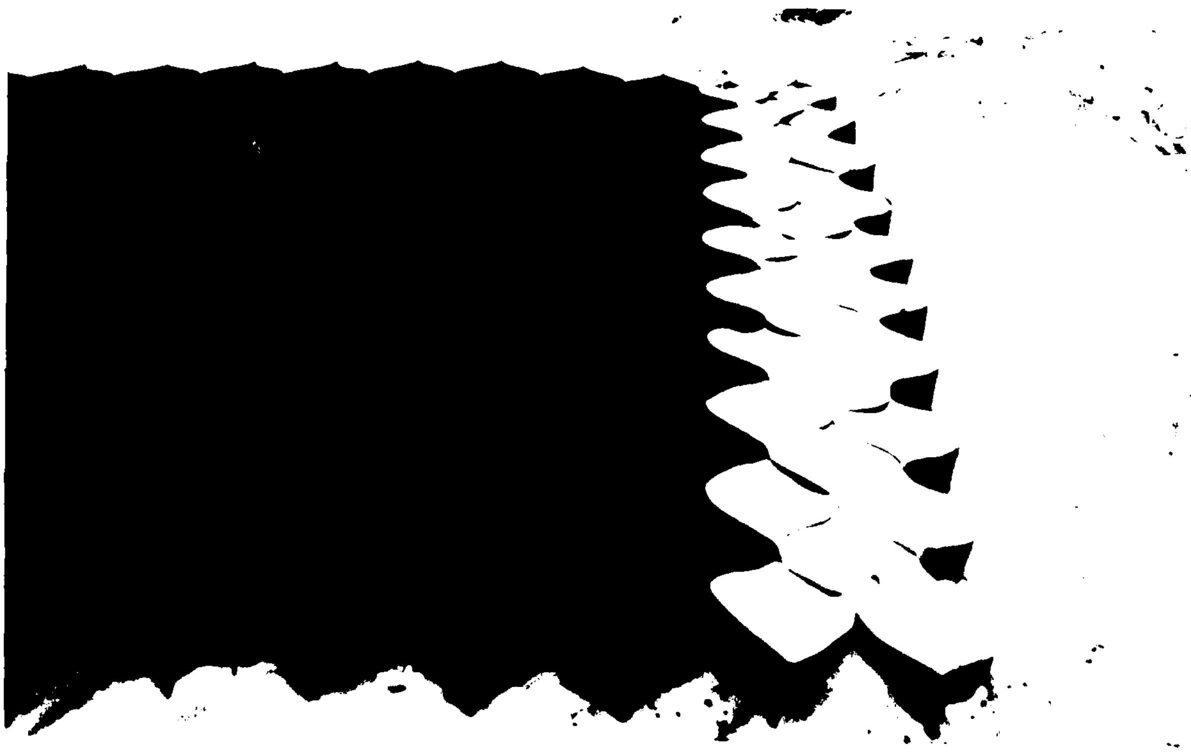


Figure 3-9 - Sand Grid Being Installed

Table 3-3 summarizes the lengths of the Sand Grid and MOMAT segments of the roadway. It should be noted that the total length in Table 3-3 is not the linear length of the roadway system since some of the MOMAT was layed parallel to and adjoining the Sand Grid to form truck staging areas and truck loading.

TABLE 3-3 - ROADWAY DIMENSIONS

MATERIAL	UNIT DIMENSIONS (ft)		NO. OF PIECES	TOTAL LENGTH	
	LENGTH	WIDTH		FEET	STATUE MILES
SAND GRID	20	8	450	9000	1.7
MOMAT	48.5	12.2	144	6984	1.3
TOTAL				15984	3.0

Time. Table 3-4 is a tabulation of times spent performing the various tasks involved in laying down the roadway. The total hours at the bottom are the times required to perform each individual task. They cannot be equated to manhours since the specific teams performing each task are not defined in the data. The installation was done on an administrative time schedule, with work occurring on 18 days in August 1984.

Manpower. Although the beach was prepared for Navy/USMC operations, Navy and Marine Corps personnel did not participate. Army and civilian units performed the work. In general, the work force included the following groups of personnel.

- An Army unit composed of an NCO and up to 40 enlisted personnel
- Four public works equipment operators
- A civil engineer and 5 civilian assistants

TABLE 3-4 - PREPARATION TIMES FOR BEACH ROADWAY SYSTEM

DATE	EVENT TIMES - HOURS							
August 1984	Survey Beach	Subgrade Prep	Lay Sand Grid	Fill Sand Grid	Water/ Compact Sand In Sand Grid	Level Beach	Lay MOMAT	Spread Asphalt
10	10.0							
11	10.0							
12								
13		8.5						
14		7.0	6.75					
15	2.0	8.5	6.25	8.5				
16		2.0	6.75	8.5				
17		3.5	4.00	8.5	3.0			
18				8.5	8.5			
19				8.5	8.5			
20						8.5		
21					7.5	7.5	6.5	
22						7.0	3.0	
23					5.0			
24					7.5			
25					7.5			
26					7.5			
27					4.5			5.0
28								9.0
TOTAL	22.0	29.5	23.75	42.5	59.5	23.0	9.5	14.0

The Army personnel operated an Army forklift and road sprinkler and manned 30 shovels to fill the Sand Grid cells. Public Works personnel operated their own equipment. The civil engineers and assistants performed the survey and layout tasks and monitored the grading and laying of the roadway.

The Public Works personnel were experienced equipment operators and performed their tasks skillfully. However, Army personnel had no previous experience setting up either type of roadway and had to learn as they proceeded.

Equipment. Table 3-5 summarizes the equipment used to perform the indicated tasks. In general, the Sand Grid proved to be very stable under the continuous truck traffic throughout the test. It eventually disintegrated in local areas, however, as a result of specific usage:

- The relatively sharp turn at the east end of the race track was eroded by the shearing loads of the tandem truck tires as they "skidded" around the turn. The asphalt coating over the Sand Grid was shoved sideways and no longer formed a sealing cap on the Sand Grid cells. This erosion was periodically patched by packing finely crushed clay-gravel into the eroded areas.
- The Sand Grid crumbled on the entry road where double rows of trucks were staged. Wheels were directed too close to the shoulder or edge of the Sand Grid causing it to cave in. This area was repaired by overlaying MOMAT to broaden the roadway.
- The roadway along the beach, west of the ELCAS was washed away by high water during a storm which occurred on 12 and 13 October, near the end of the Army operations (see Figure 3-10).
- Subsequent to one storm, dozers had to cross the Sand Grid to assist in re-floating several beached causeway sections. The dozer tracks destroyed the asphalt seal and crushed the walls of the Sand Grid.

The MOMAT panels are laid on a flattened sand grading, bolted together at the ends, and secured along their sides by intermittent stakes which resist sideways motion and prevent the roadway from being lifted by wind. Some observations are listed below:

- The rolling loads of passing truck wheels causes sand to squeeze sideways out from under the MOMAT resulting in wheel ruts

TABLE 3-5 - EQUIPMENT USED IN ROADWAY PREPARATION

TASK	EQUIPMENT		
	TYPE	QTY	OWNER/ OPERATOR
• Survey/Layout Roadway	String, tapes, stakes		Civil Engineers
• Sub-Grade Preparation	Dozer	3	Public Works
	Front-end Loader	1	Public Works
	Shovels	30	Army
• Lay Sand Grid	Front-end Loader	1	Public Works
	Forklift	1	Army
• Fill Sand Grid	Dozer	2	Public Works
	Front-end Loader	3	Public Works
	Shovels	30	Army
		2	Public Works
• Water/Compact Sand	Road Sprinkler	1	Army
	Front-end Loader	2	Public Works
	Vibrator Compactor	1	Public Works
	Roller Vibrator	1	USN
• Level Beach, Clean Up	Front-end Loader	3	Public Works
	Dozer	3	Public Works
• Lay MOMAT	Forklift	2	Army
	Dozer	2	Public Works
• Spread Asphalt, Sand, Roll	Asphalt Spreader		Public Works
	Front-end Loader		Public Works
	5-Ton Roller	1	USN
	Shovels		Army

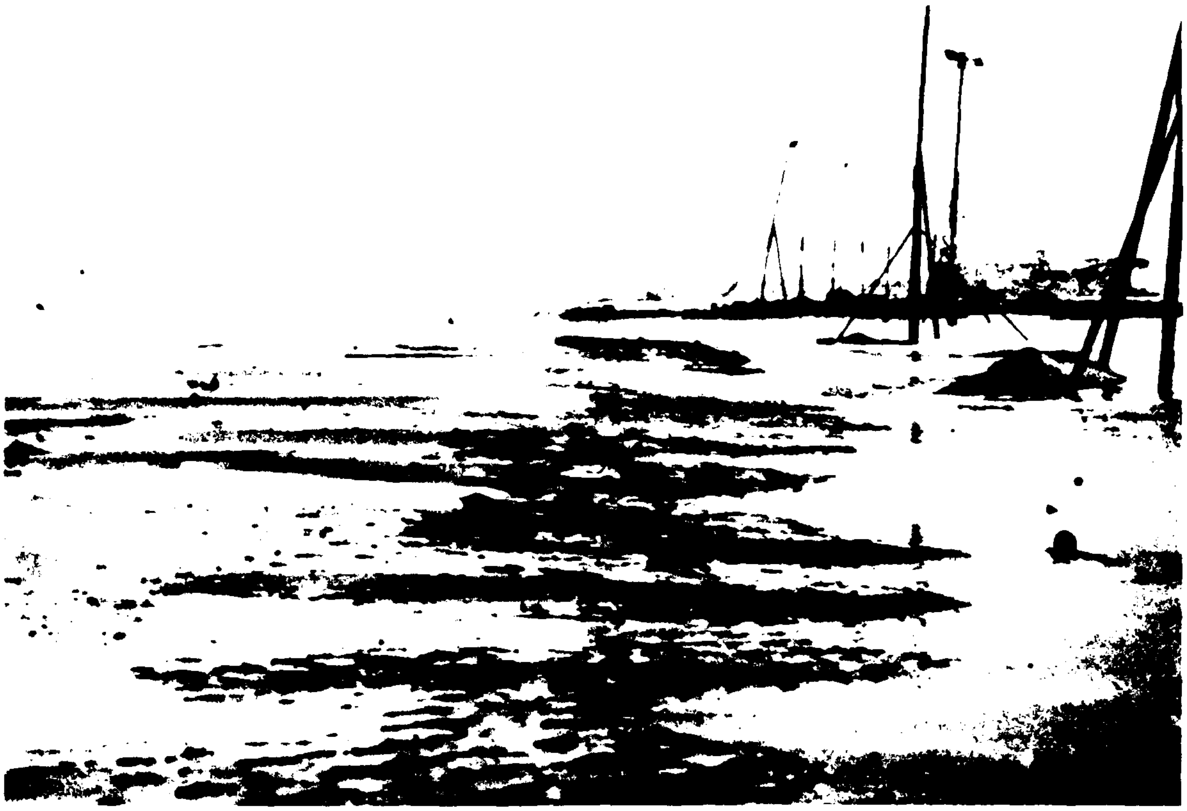


Figure 3-10 - Storm Damage to Beach Roadway

developing in the sand roadbed. The rolling load also forces the MOMAT forward causing waves to develop. These two motions tend to pull the stakes out of the sand and the problem accelerates. Therefore, the MOMAT roadway must be periodically maintained by lifting sections, leveling the sand roadbed, and then relaying the MOMAT and restaking. The time interval between maintenance actions is a function of the traffic, the load, and the firmness of the roadbed.

- As with Sand Grid, MOMAT is destroyed (cut) by steel-cleated tracked vehicles. One convenience, however, is that a section can be rolled back to allow the passage of tracked vehicles.
- MOMAT is light enough so that sections can be shifted by personnel. For example, it was rolled out from the end of the LACV-30 concrete runway to the ramp of a beached LCU to provide a roadway for offloading a helicopter. After the offload, it was rolled up and stored.
- The MOMAT along the Navy offload area, used for truck loading mats, was washed away in a storm (see Figure 3-11). Water rapidly eroded the stake foundations and allowed the panels to blow/float free.

Figure 3-11 - MOMAT Truck-Loading Mats Washed Away by Storm

Procedures. Aside from the sequential lists of tasks addressed in the preceding tables, the only written procedure was a technical manual supplied with the MOMAT. No Army Service Manual exists for this type operation.

Environment. Segments of Sand Grid and MOMAT were washed away by high water during several storms. These road systems are not resistant to erosion from this extreme weather condition.

High winds tend to cover both materials with sand drifts. If the resulting layer is only a few inches deep, there does not appear to be a deteriorating effect on either the road or the traffic movement. However, MOMAT will develop ruts and waves even if covered with a layer of sand and must be maintained. This becomes difficult when covered by several inches of sand. One observed disadvantage to wind blown sand on either surface is that the edge of the roadway becomes obscured and must be marked (flags, stakes, etc.) to guide the traffic.

During the roadway installation, there were several days when temperatures were in the 90's accompanied by high humidity. These conditions made it difficult to perform manual labor, especially in the hot sand which reflects the heat.

Conclusions.

- As seen in Table 3-5, the majority of the equipment and skilled operators were nonmilitary. Therefore, the roadway installation cannot be considered a demonstration of the Services' capability to prepare a beach for a throughput operation.

- Service Manuals are needed to provide information on: procedures, equipment, materials, and manpower for installing a beach roadway system. Also, criteria are needed for: vehicle restriction, minimum turning radii, maintenance requirements, and repairing procedures.

- The Sand Grid and MOMAT roadways both performed satisfactorily under normal operating conditions. Neither material can withstand tracked vehicle traffic. The durability of each is dependent on proper operating and maintenance procedures.

3.1.2.2 Elevated Causeway (ELCAS)

General. The ELCAS was beached at 1100 15 September and it was declared operational at 0800, 25 September.

Time. *Figure 3-12 is a time line diagram of the various tasks performed* and the weather interruptions which occurred during the installation of the ELCAS.

Manpower. The installation personnel consisted of two 32 man teams, one each from Amphibious Construction Battalion (ACB) ONE and TWO. The environmental and equipment difficulties encountered resulted in a strained working relationship between the units. This relationship resulted in additional delays while debating the proper course of action.

Equipment, Procedure, and Environment. The time, equipment, and procedures, of the various phases of this installation are discussed below. The effect of the environment is also included.

Transport - The ELCAS was brought to the beach with the 12 sections connected in the arrangement that they would be installed. An additional section was attached to carry piling for the pierhead. A four-section Causeway Ferry accompanied the ELCAS to carry piling, the jacking systems, the turntable, and other pieces of equipment. Figure 3-13 gives the arrangement of the ELCAS and ferry sections and the layout of the equipment they carried.

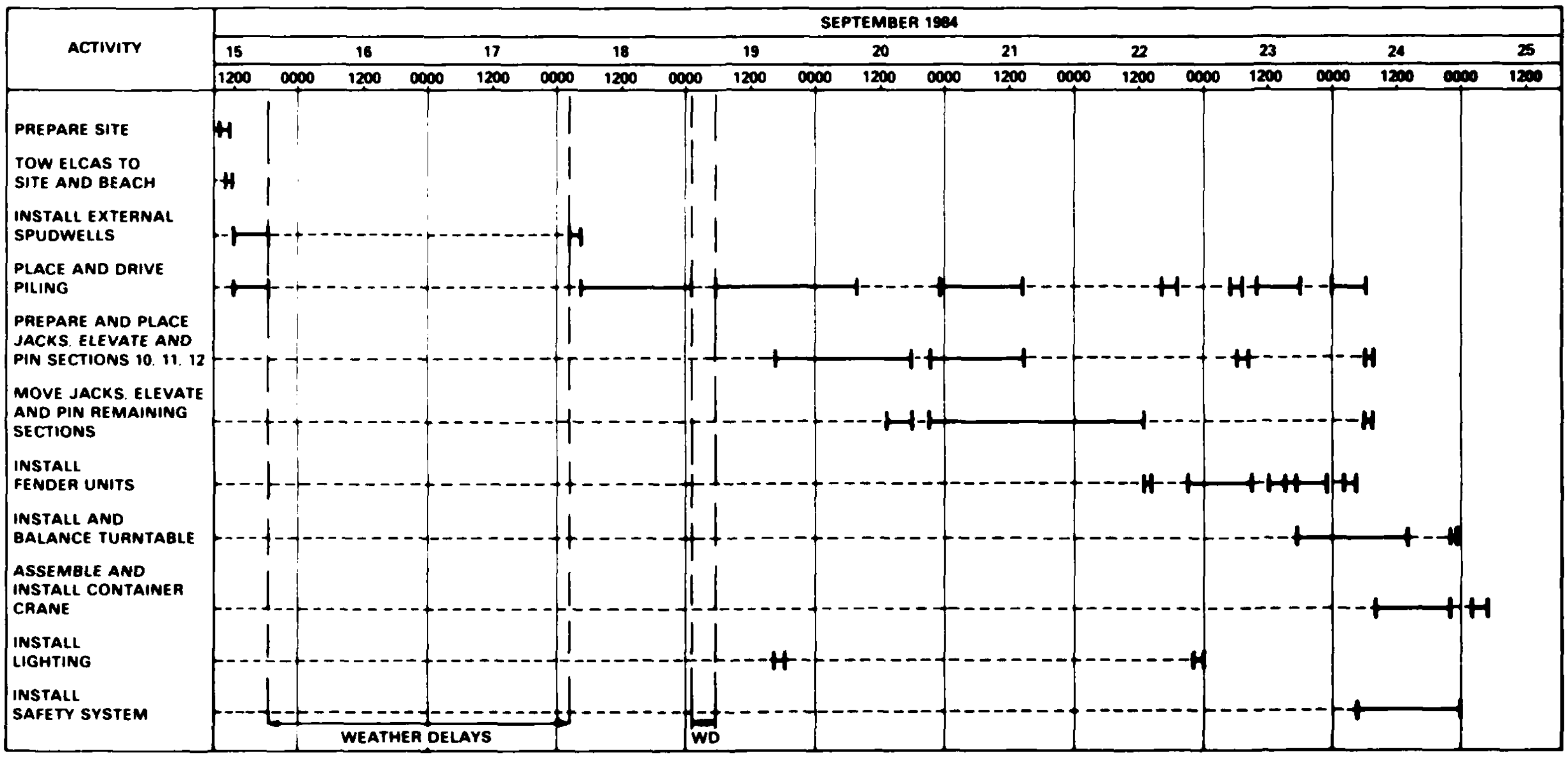


Figure 3-12 - ELCAS Installation Times

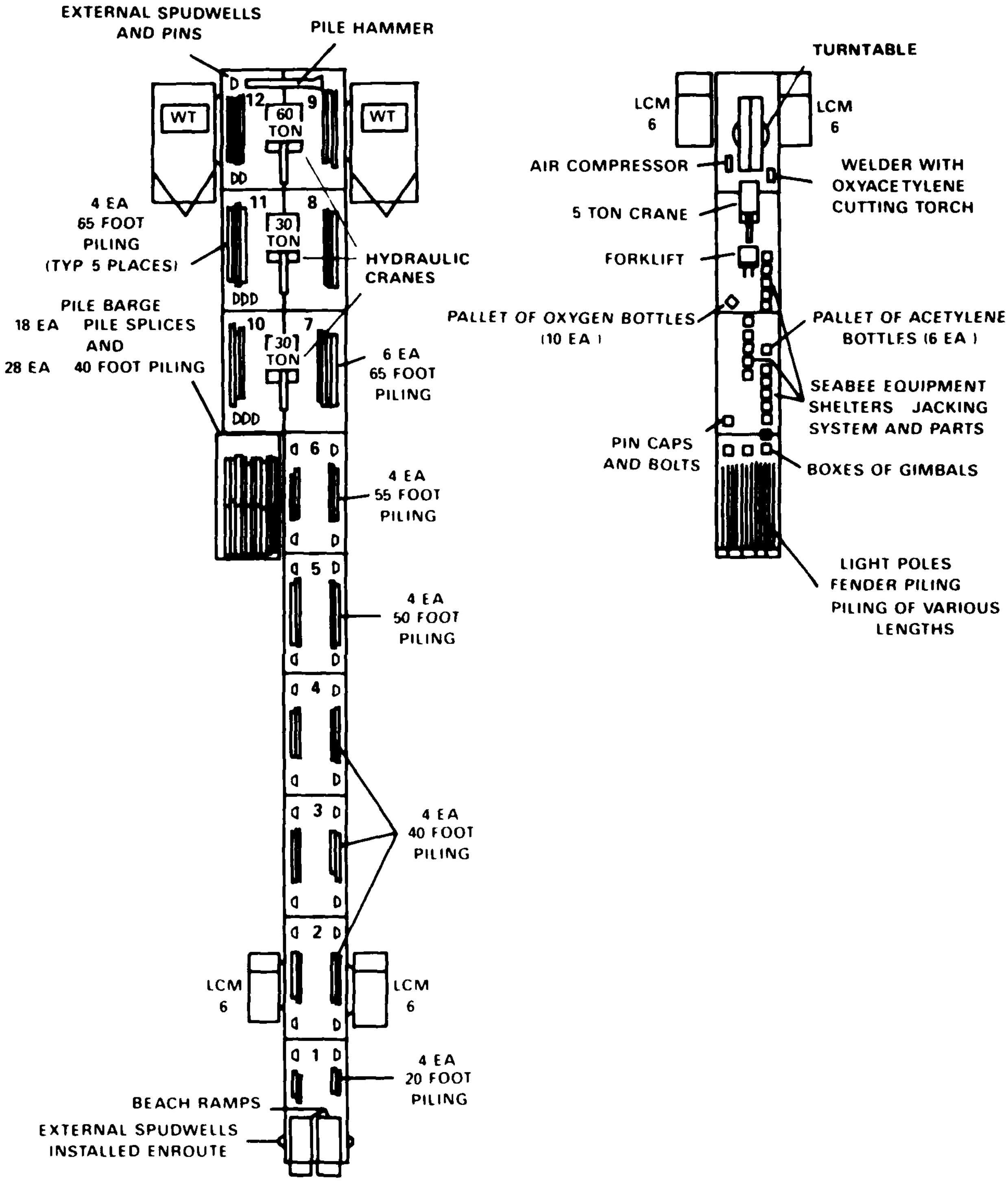


Figure 3-13 - Equipment Layout on ELCAS and Ferry during Transport to Beach

A large portion of the equipment and materials that were used for ELCAS installation was brought to the beach administratively (over-the-road). Table 3-6 provides a comparison of the way the ELCAS equipment was deployed for the JLOTS II Throughput Test versus the way it was deployed aboard the LASH ship during the JLOTS II Deployment Test. While virtually none of the causeway section loads were identical to the LASH test loads, most were similar enough to be considered to have been demonstrated. The items which were not demonstrated during the LASH Test are either small miscellaneous equipment or large items similar to items that were demonstrated.

Note that the loadout of an entire ELCAS system on a LASH ship has not been planned or demonstrated. The 17 sections brought to the beach during the Throughput Test all carried equipment while only the top 8 sections loaded aboard the LASH ship could have equipment on board. A LASH ship loading plan in which the ELCAS system is 'operationally' loaded is needed. It must be planned that some measure of time (estimated at one day) will be required to shift from the configuration loaded on the LASH ship to that hitting the beach.

Beaching - The ELCAS was brought to the beach by 2 'homeport' warping tugs. The Causeway Ferry was propelled by 2 LCM-6's. The warping tugs are similar in capability to the SLWT so the change will have little or no influence on the delivery of the ELCAS to the beach. A single CSP/SLWT will be an improvement over the 2 LCM-6's handling the Causeway Ferry.

Prior to beaching, two external spudwells were installed on the beach end of the first section. This required approximately 1 hr. One of the first steps in ELCAS installation after hitting the beach is to install the remaining external spudwells. A great savings in time would result if the sections could be deployed with the external spudwells attached. This was not attempted during the JLOTS II LASH loadout.

The approach to the beach was performed according to normal procedures. Once the ELCAS reached the beach, two dozers were used to push the beach end into a slot in the beach which had previously been cut. The dozers then attached their winch wires to the first section and pulled the ELCAS up into the slot to ensure that its end was above the high water mark, reducing the chances that the sand supporting the end ramp would be worn away by wave action at high tide.

TABLE 3-6 - COMPARISON OF TRANSPORTATION OF ELCAS DURING THROUGHPUT AND DEPLOYMENT TEST

Item	Throughput Test 0 - Operational A - Administrative		LASH Ship Deployment Test	Comments
Causeway Sections	0	17 - All Carrying Equipment	11 - 7 Carried the Equipment listed below	8 of the ELCAS sections carried only piling and external spudwells.
Warping Tugs	0	2 - Homeport Tugs	1 - SLWT	ELCAS will deploy with CSP/SLWT's
LCM-6	0	4	Not Deployed	Will be replaced with CSP/SLWT.
60-Ton Hydraulic Crane	0 A	1 - Failed 1 - Replacement	1 - Required individual section	ACB's consider replacements available in AOA. LASH lift could include other miscellaneous equipment.
30-Ton Hydraulic Crane	0	2	1 - Required individual section	ACB's consider replacements available in AOA. LASH lift could include other miscellaneous equipment.
140-Ton Crane Body	A	Driven over road	Required individual section	
Boom & Ctwts	A	2 Truck Trailers	Not Deployed	
Bulldozer	A	2 Truck Trailers	1 - Carried on section with forklift	ACB's consider these available in AOA before ELCAS arrives.
Forklift	0		1 - Carried on section with bulldozer	

TABLE 3-6 - (cont)
COMPARISON OF TRANSPORTATION OF ELCAS DURING
THROUGHPUT AND DEPLOYMENT TEST

Item	Throughput Test 0 - Operational A - Administrative		LASH Ship Deployment Test	Comments
Piling/Splices External Spudwells	0 0	Distributed over sections and on 2 piling sections	One section full of piling Not deployed	Piling and external spudwells could be deployed on sections with other equipment but this was not demonstrated.
Seabee Shelters	0	16 - Spread over 2 sections	Not deployed	Contain jacking system, spare parts etc.
Fender Units	0	3 - Floated in	2 - Carried on one section	Technique of launching fenders from section not demonstrated.
Turntable	0	Disassembled	Assembled on section	
Air Compressor	0	1 - Carried on sections	Not Deployed	These are miscellaneous small items which can be distributed or grouped on a section for deployment.
Generator	0	2 - with other	"	
Welder with O/A	0	1 - Equipment	"	
Lighting System	0	1	"	
Pile Hammer	0	2	"	
Misc. Equipment	0	Pallets & Boxes	"	
Cherry Picker	0		"	
Camp Support	A	Required for 70 personnel	"	Includes trucks, jeeps, tents, etc.

External Spudwell Installation - External spudwells were installed along the roadway sections after beaching (Figure 3-14). The spudwells hold the piling during driving and secure the causeway sections to the piling after the sections have been elevated. The spudwells are pinned to the side of the causeway sections using a 30-ton capacity hydraulic crane and 4 personnel. This combines two very dangerous work evolutions: working over-the-side and working with a crane on a floating platform.

Placing and Driving Piling - Immediately after beaching, a 30-ton and a 60-ton capacity hydraulic crane began placing piling at the seaward end of the pierhead. After a few of the 65-ft piling had been dropped through the spudwells, the 60-ton capacity hydraulic crane began to drive them while the 30-ton crane continued placing them (Figure 3-15).

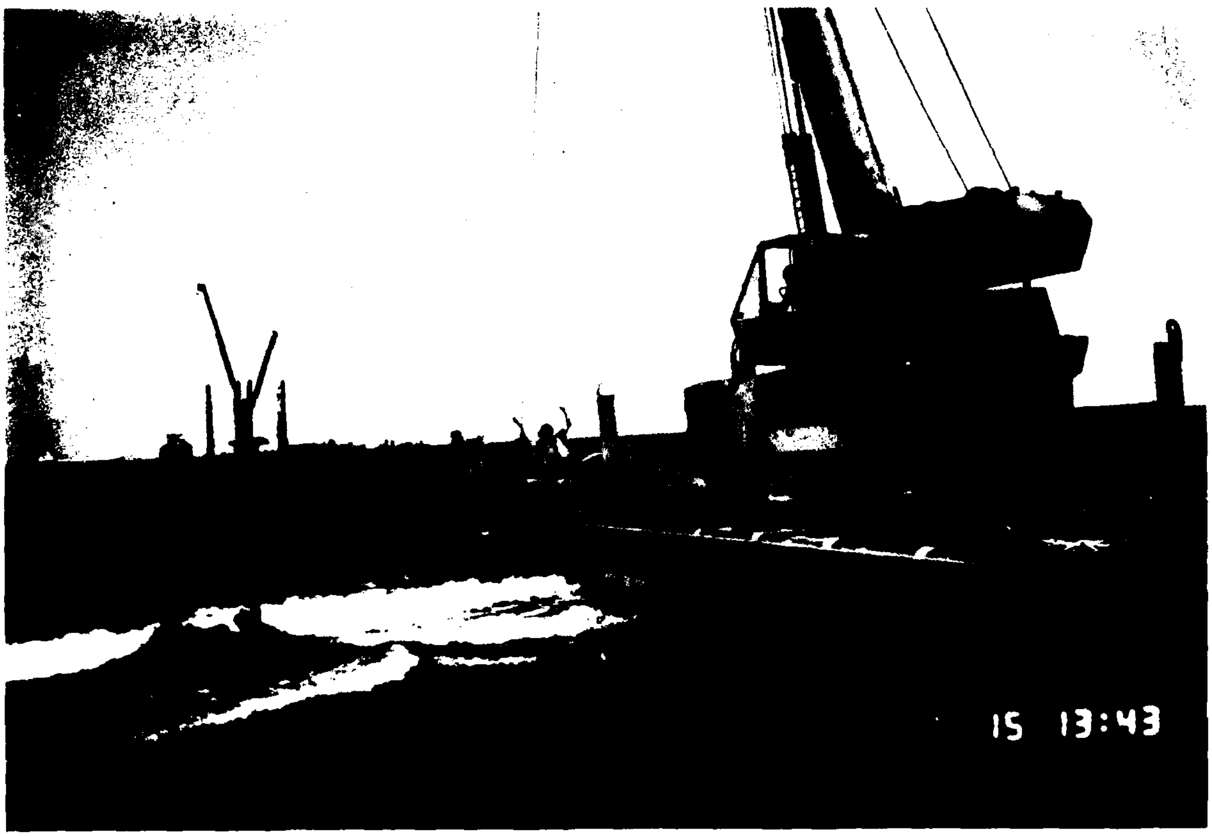


Figure 3-14 - Installation of External Spudwells

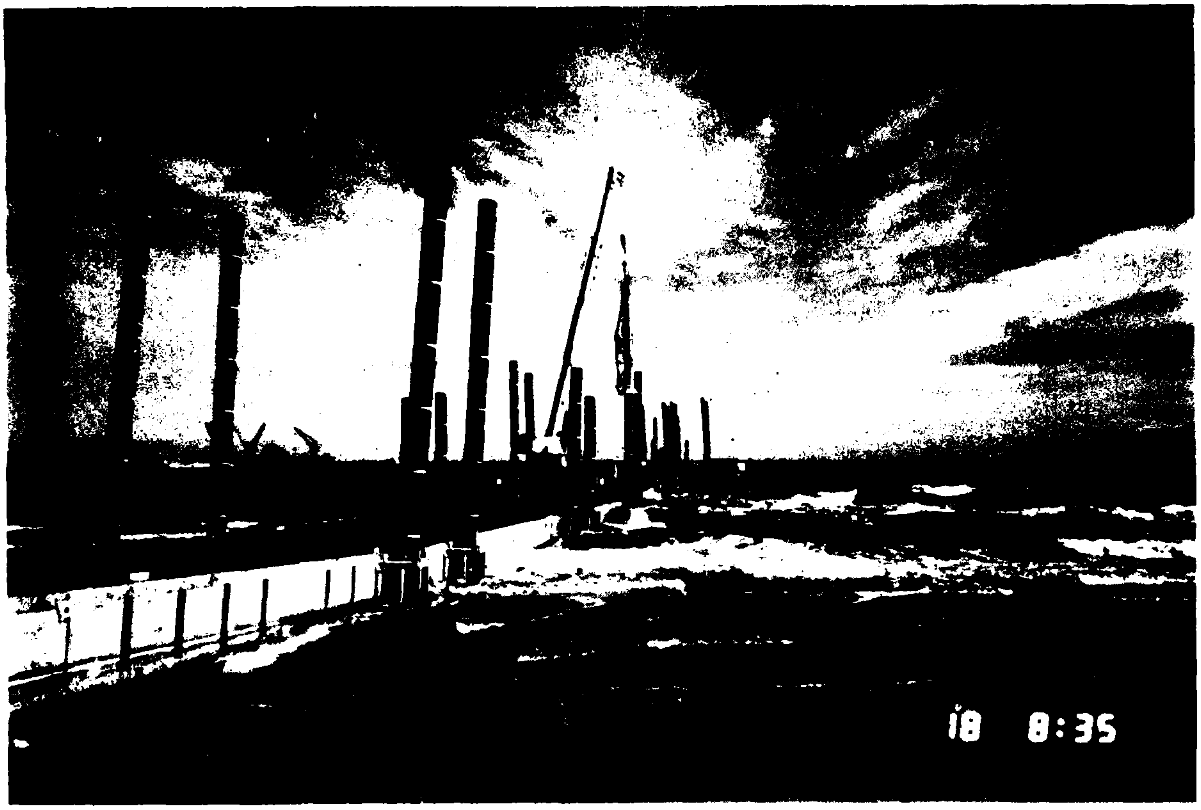


Figure 3-15 - ELCAS Pile Driving

Crane operations during pile driving are sensitive to the motion of the platform and the wind. The former causes the boom tip to move, which swings the load (pile hammer), and the latter pushes the load side ways, also inducing motion. The combination is dangerous and forces crane operations and thus pile driving to stop.

A large number of failures occurred on the hydraulic cranes. Many of these were due to corrosion in the electric control systems. An outrigger on the 60-ton crane failed. Since no spare parts were available, it was subsequently replaced by a civilian rental 60-ton crane.

After driving 2 piling on the pierhead and placing 8 others, rising wind and sea state forced the operation to stop. The wind was approximately 20 knots and waves were 3 to 4 ft when pile driving was discontinued. Several attempts were made to resume operations, but it was 3 days later before pile driving on the pierhead resumed.

A pile is considered driven when the blows per foot reach 35 for the roadway, 55 for the basic pierhead, and 75 for piling where the container crane will sit. The sub-soil at this site contained areas of soft material which required extra lengths of piling to be spliced onto the original piling. In several cases, settlement occurred after the blow count had been assumed to be reached. This required additional driving and splicing

of piling as well as extra jacking of sections to keep the pierhead level. The difficulty could have resulted from a failure of the soil to support a sustained load or from an error in the blow count. Counting blows accurately becomes very difficult when the causeway section the counter is standing on is moving relative to the piling being driven. A more reliable method of determining blow count is needed and a spread footing should be developed to reduce the length of piling required under soft bottom conditions.

The majority of the piling used for the pierhead sections and the fender system were transported on extra causeway sections. This method required the use of extra sections. However, it did provide a relatively clear work area for the crane.

Jacking - The jacking system was transported on the Causeway Ferry which was moored to the pierhead sections of the ELCAS. After the piling were driven on sections 10, 11, and 12, the jacks were placed on appropriate piling, the sections separated from the rest of the pierhead, and jacking commenced (Figure 3-16). Some delays due to malfunctioning

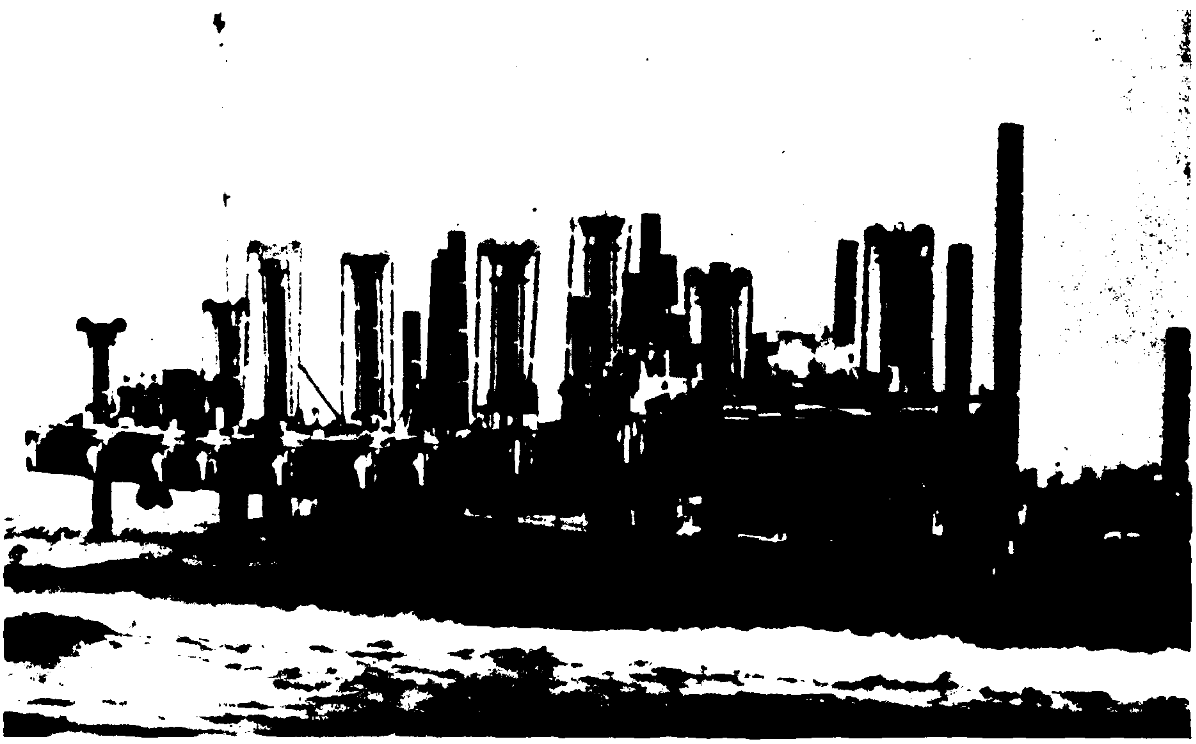


Figure 3-16 - ELCAS Jacking

jacks occurred at the start, but these were fixed and the jacks were then relatively trouble free. However, as mentioned above, problems did occur due to pile settlement. These problems were resolved after the rest of the ELCAS had been elevated and pinned in place. The pins on the sinking piling were pulled and the piling redriven, and a new pin hole cut (pinning discussed below). The remaining 3 pierhead sections (7, 8,and 9) and the roadway sections were elevated in one continuous string. This required that a forklift transport jacks from the elevated and pinned pierhead end over sections hanging on jacks to the sections on the beach end which were still floating. This has become standard procedure, but is not yet reflected in the ELCAS manual.

Pinning - Once the causeway sections were jacked up to an appropriate level, a survey was conducted and the piling marked at the required elevation. Holes were cut through the piling at this elevation. Steel pins (4 in. x 5 in. rectangular) inserted through these holes, and bolts and caps installed so that the causeway section actually hangs from the pins. On several pilings the accuracy of the laser survey equipment which marked the pin elevations was questioned. There appeared to be a slop of +/- 1 in. allowed by the laser level which exceeds the allowed 3/4-in. tolerance of the bolts in the pinning system. The result was that the pin holes had to be patched and recut or the piling redriven and the hole recut. In both cases additional delays occurred.

Pierhead Side-Connector - Sections 7, 8, and 9 must be side-connected to sections 10, 11, and 12 to form the pierhead. The hydraulic equipment which was needed to align the sections and operate the side-connectors had been left on the Causeway Ferry which brought ELCAS equipment to the test site. This Causeway Ferry was at anchor offshore during final elevation when the side-connection should have taken place. A decision was made to complete the pinning of Sections 7, 8, and 9, and to side-connect at a later time. Unfortunately, the sections settled slightly and the side-connection gear could not be aligned for proper connection of the sections. The pierhead sections were then secured together by welding 2-1/2-in. high steel grating between the sections on top of the assembly angles in front of the container crane and by welding angle iron between the sections at regular intervals for the remainder of the connection.

Fender Unit Installation - The fender unit was attached to the side of Sections 10, 11, and 12 of the pierhead after the pierhead was elevated and pinned. External spudwells were installed on the pierhead first, after which the fender units were floated into place by a warping tug which held them while a crane on the pierhead stabbed piling through the external spudwells and through spudwells in the fender units. These 9 pilings were then driven and pinned to the pierhead to provide extra support.

Turntable - The turntable base was lifted from the Causeway Ferry and installed on Section 9 by the 60-ton crane. The base was leveled and then tack welded in place.

The turntable top was then lifted into place on the base. The access ramps were installed, the air-driven chain drive installed, and the air cushions were adjusted to provide proper flow while the turntable rotated. During this procedure a small hole was discovered in one air bag, but it was decided to leave it since it didn't affect turntable operations. A spare was on hand if it worsened.

Container Crane - The container crane was the last major piece of equipment to be installed. The 140-ton capacity truck crane was driven onto the ELCAS without its boom or counterweights to reduce the loads on the roadway causeway sections. The boom sections were then brought out by trucks and attached to the crane (Figure 3-17). Delays occurred during this procedure due to the loss of a boom pin and the tangling of the main wire while reeving the hook block.

The crane was then installed in its position on Section 11. Some debate arose due to the difficulty of installing the load spreading outrigger pads on the appropriate piling. The position directed by the ELCAS Installation Manual[8] was eventually selected and the crane installed.

The counterweights were then installed. They were difficult to fit and required about 2 hr before they were in place.

Lighting and Safety System - The light poles were installed in piling along the roadway and on the pierhead. Generators were positioned on a special platform on the roadway and on the beach end of Section 10.

The safety nets were strung around the entire ELCAS (except the turntable, Section 9). The nets were hung from cables strung through chain link welded to piling. In the operational area adjacent to the container

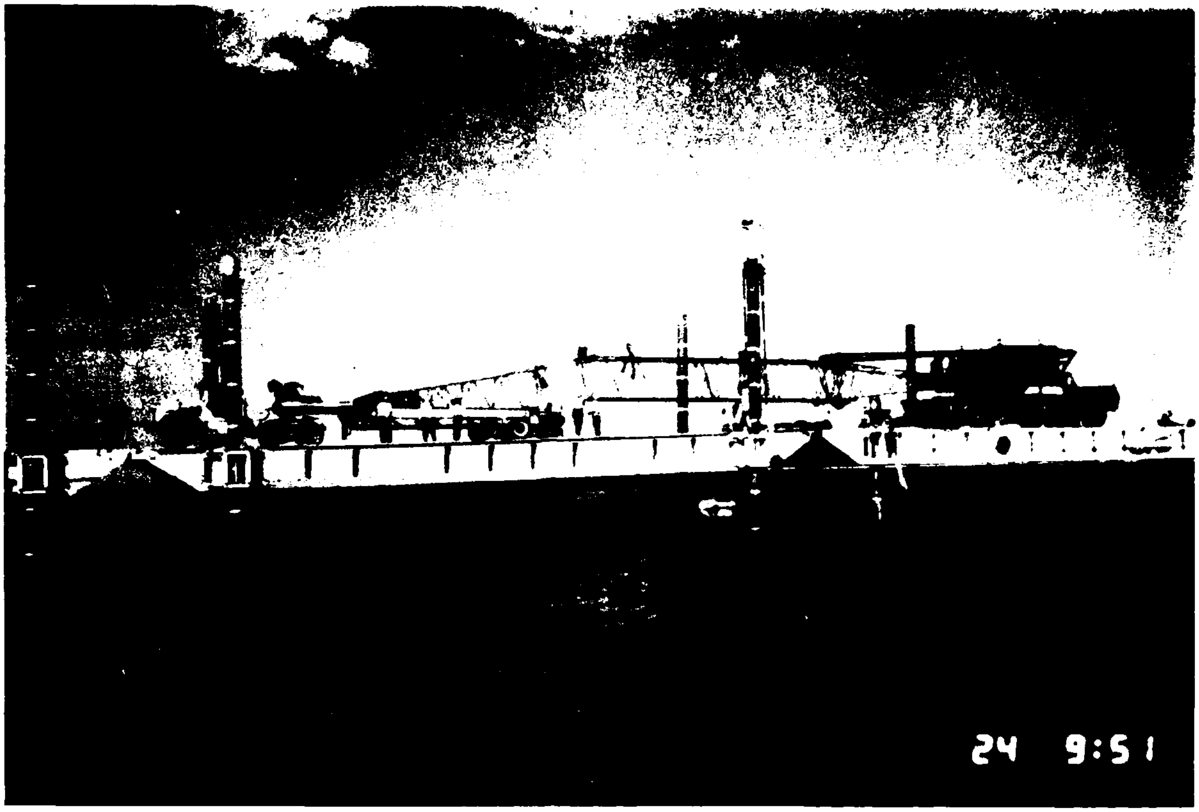


Figure 3-17 - ELCAS Container Crane Boom Assembly

crane, the net was laid across 5-ft long beams which cantilevered out from the ELCAS deck.

Summary - The installation of ELCAS required 10 days overall, and 7 days not counting weather delays. The estimated completion time had been 3-5 days. The problems previously described and summarized below all contributed to the long installation period.

- Soft soil greatly increased required pile driving time. Blow count errors resulted in subsequent pile settlement during elevation. This forced crews to redrive many piling which required extra movement and set-up of the pile driving crane.
- Jack problems and pile settlement due to soft soil increased elevation time.
- Survey problems and pile settlement increased pinning time.
- Assembly and installation difficulties of the turntable and crane extended the completion time.

It was readily apparent that ELCAS installation could not take place at this site during a high SS2 or at least a SS3. The quartering direction of the waves caused a rolling of the sections which made pile handling and driving very dangerous and virtually impossible.

3.1.2.3 RTCH and LACH Cargo Sites

3.1.2.3.1 RTCH Site

Causeway Ferries beached for offload at two marked locations west of the ELCAS. Each causeway was offloaded by two RTCH's which, in turn, loaded the containers onto trucks for delivery to the Marshalling Yard.

The truck loading mat consisted of a MOMAT roadway laid parallel to and adjoining the Sand Grid as shown in Figure 3-18. The MOMAT was layed along the stretch of beach bracketing the causeway/RTCH container offload sites. This arrangement allowed truck loading to be conducted without interfering with the traffic flow along the roadway. As each loaded truck departed, an empty one was called from the queue to the loading position.

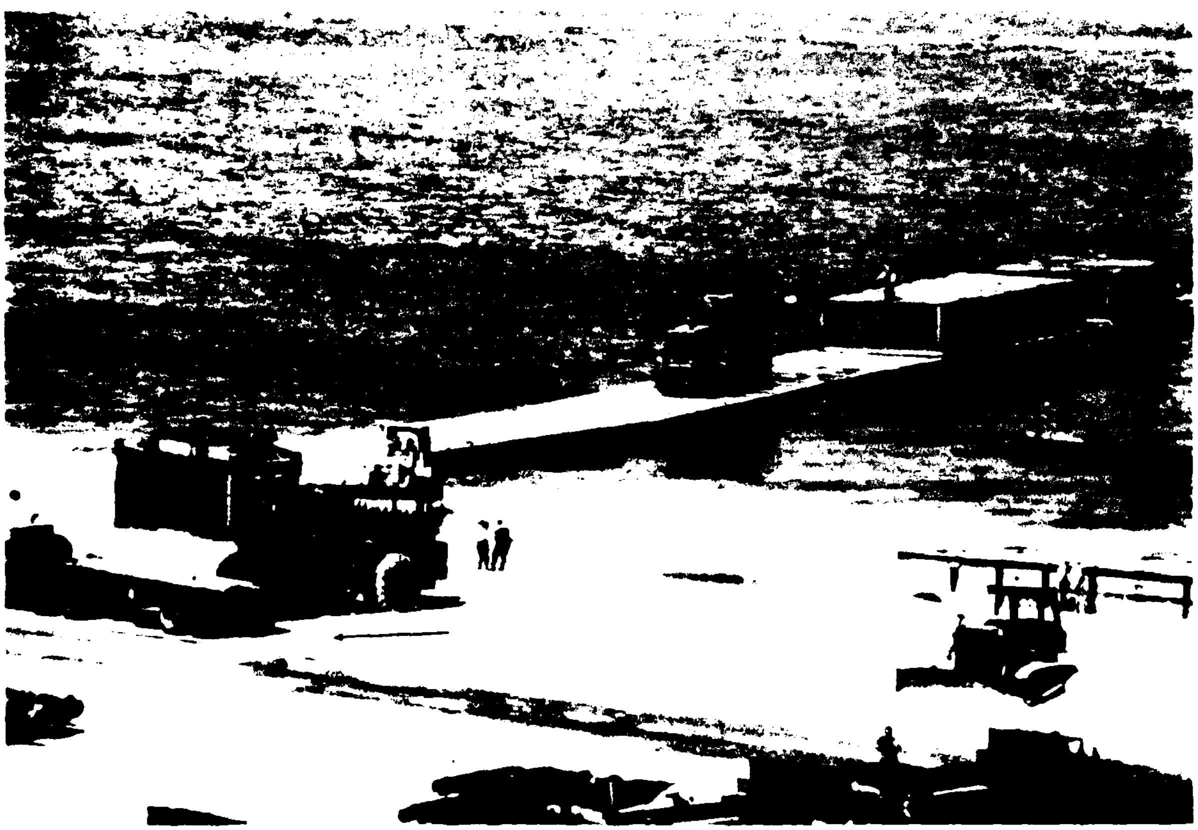


Figure 3-18 - MOMAT Truck Loading Area at RTCH Site

The edge of the MOMAT was slightly overlaid on the adjacent Sand Grid, creating a stable transition from one to the other. During the course of the Navy test, however, the roadbed under the MOMAT was not maintained and tire ruts and waves formed causing the MOMAT to shift out of position. Had the Navy test been longer, maintenance would have been necessary to preclude truck traffic from bogging down.

One advantage of MOMAT for the truck loading position is that it can easily be shifted along the beach to new Causeway Ferry beaching positions to take advantage of dips/holes in the sandbar that were present offshore. This was not done during the test, however.

The Causeway Ferry beaching positions were identified with colored markers/flags to guide the approaching causeway during daylight operations. At night, various marking techniques were used such as flashing jeep headlights, waving lighted wands, and lantern reflectors. Neither day or night markings/signals guided the coxswain to the beach on a perpendicular course. This became apparent when approaches were made during periods of high tidal current. The causeway would be pointed at the marker, but would approach at an angle to the beach and, on occasion, would have to retract and try again. It is recommended that the marking system prescribed in Beachmaster Unit Two Instruction 5400.2F be used. The procedure would be to place two markers/red lights in a range to indicate a track to the approaching causeway.

Several yards inland from the roadway a line of temporary lights on poles provided sufficient lighting for offloading activities and road traffic. The power was provided by portable generators and lighting could be controlled in segments.

3.1.2.3.2 LACH Site

The LACH site was at the west end of the race track and consisted of three beaching positions marked similar to the RTCH site. Each beaching position had an associated truck loading position surfaced with MOMAT projecting seaward at an angle of about 60 deg to the Sand Grid roadway as shown in Figure 3-7. The MOMAT was laid overlapping the Sand Grid to prevent deterioration of the system from traffic crossing an otherwise unprotected edge of the Sand Grid. Empty trucks would back onto the

loading mat. Road traffic would be momentarily halted while the truck maneuvered off the road onto the mat.

The material, labor, and equipment required to install the LACH truck-loading mats are incorporated in the discussion of Sections 3.1.2.1

3.1.2.4 Marshalling Area

Two container and one breakbulk marshalling areas were established in locations shown on Figure 3-19. Table 3-7 lists the area of each Marshalling Yard. The stowage plan for both containers and breakbulk was basically the same. The cargo was stacked in rows with aisles between for material handling equipment. The container yard aisles were 50-ft wide for RTCH operation, while the breakbulk yard aisles were 20-ft wide for forklifts. The locations for the rows were marked at each end and the truck traffic lanes established. Check-in points were also established to complete the cargo documentation cycle.

The areas used were flat with sandy soil and clear of brush and trees. There was paved roadway through and around Marshalling Yard A, and along the edge of Marshalling Yard B and C.

3.1.3 Bulk Fuel System Installation and Preparation

The installation and preparation of the bulk fuel systems consisted of the following:

- The Amphibious Assault Fuel Supply Facility (Navy)
- The Amphibious Assault Fuel System (USMC)

3.1.3.1 AAFSF

General. Installation of the AAFSF began at 1215 on 4 October and was completed at 1900 on 5 October.

Time. Table 3-8 list the times for installation of the major subsystems of the AAFSF (Figure 3-20).

Manpower. The crew used to install the AAFSF was a mix of personnel from ACB ONE and ACB TWO. ACB ONE personnel had much more experience installing the AAFSF since they had been involved in the developmental testing. The craft used to assist in the installation were provided by ACB TWO whose personnel had minimum training and experience with the AAFSF. Three new

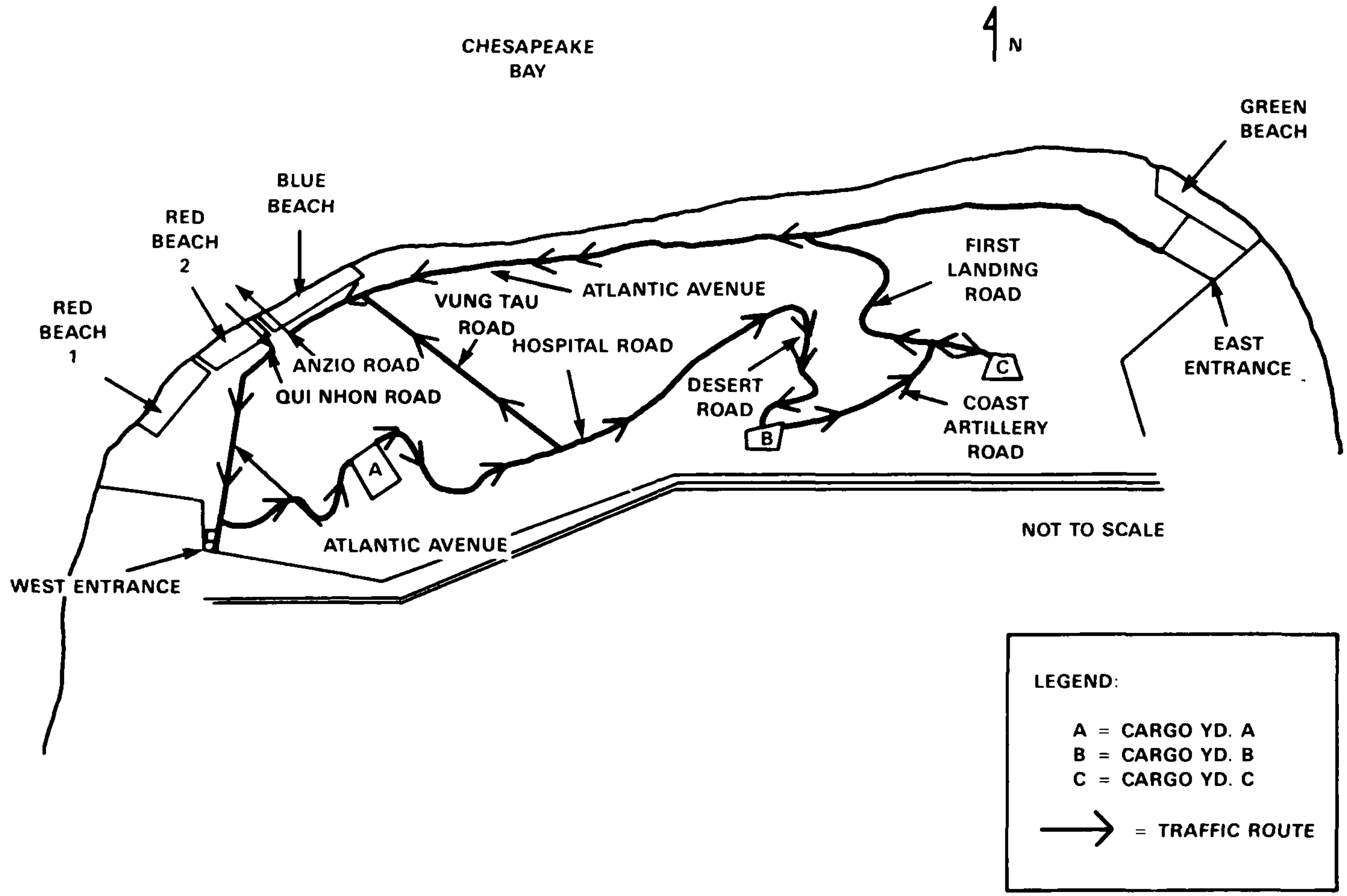


Figure 3-19 - JLOTS II Dry Cargo Operations Marshalling Area Layout

TABLE 3-7 - APPROXIMATE MARSHALLING YARD DIMENSIONS AND AREA

Yard	Dimensions	Area	Distance from Beach By Road
A-North*	500 ft x 368 ft	184,000 sq ft	1.2 mi
A-South	500 ft x 500 ft	250,000 sq ft	
B	Odd Shape-Approx 350 ft x 400 ft	130,000 sq ft	2.9 mi
C	600 ft x 250 ft	150,000 sq ft	3.8 mi

*A-North was separated from A-South by a paved road which was used for truck transit.

TABLE 3-8 - INSTALLATION TIMES FOR THE AAFSF

Date	Time	Event
10/4/84	0830-0925	Prepared Beach.
	0925-1830	Deployed hoseline system and power cable.*
	1413-1446	Deployed bow mooring #1.
	1505-1730	Deployed bow mooring #2.**
	1757-1821	Deployed stern mooring #1.
10/5/84	0858-0938	Deployed stern mooring #2.
	1218-1608	Deployed electric pump system.
	1714-1859	Deployed 2 towable fuel bladders.
10/6/84	0936-1140	Connected hoseline to electric pump.
		Bladder 3. No data - launched near Little Creek and towed to tanker.

*Includes 2-hr delay due to failure of SLWT steering. Allowed hoseline to tangle with previously installed Army hoseline nearby.
**Includes 2-hr delay to repair damaged reaction vessel.

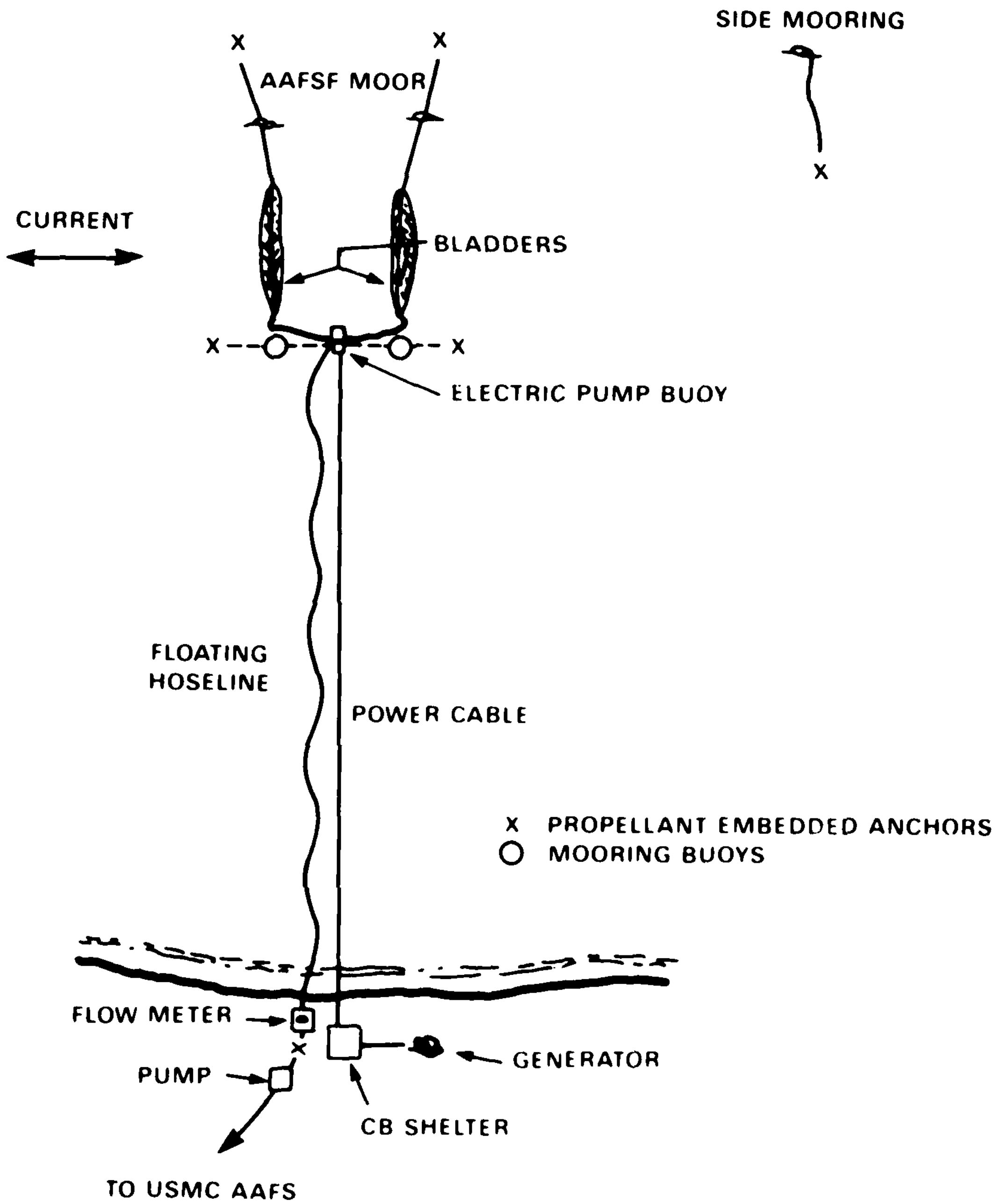


Figure 3-20 - Amphibious Assault Fuel Supply Facility

SLWT's were used during the installation and ACB TWO personnel had very little experience working with them.

Personnel with incorrect ratings were used as Boatswains Mates. These personnel were not experienced in basic line or craft handling.

The personnel used throughout the installation were:

AAFSF Crew	20
Vessel Crews (3-SLWT & 2-LCM-6)	14
Beach Master Unit	8

Equipment. The equipment in the AAFSF and that used during the installation is listed below.

- Propellent Embedded Anchor (PEA) Assembly	5
- Bow Mooring Assembly	2
- Stern Mooring Assembly	2
- Side Mooring Assembly	1
- Electric Pump Buoy	1
- Towable Bladder	3
- Beach Station	1
- Generator (60 kw)	1
- Pump	1
- Hose on Buoyant Fuel Hosereel	3,000 Ft (approx)
- Power Cable on Hosereel	2,500 Ft
- Causeway Section, Nonpowered	3
- Warping Tugs (SLWT)	2
- LCM-6 Tender Boats	2
- LARC-V	2
- Bulldozer	1
- Air Compressor	1

- Throughout the installation and operation of the AAFSF, use of the SLWT's suffered from frequent steering problems and lack of familiarity of the operators with these new craft. Both of these problems are being addressed, the first by design changes and the second by training.
- The field radios used were very unreliable and often prevented communication between craft. This prevented the OIC from directing operations anywhere but his immediate location (on a SLWT) and resulted in tasks being done one at a time rather than simultaneously.

Procedures. The propellant embedded anchors were installed first using a SLWT, and a nonpowered causeway section. This proceeded well, and the pull test on one anchor to 20,000 lb was successful.

The power cable and hoseline were deployed from hose reels on nonpowered causeways with SLWT's attached. The nonpowered section was beached and a messenger line taken ashore by a LARC-V. The end of the cable/hose was then pulled and secured on the beach. The SLWT then pulled the nonpowered section away from the beach as the cable/hose was unreeled. Midway out, while deploying the hoseline, the SLWT suffered steering problems and was carried by the current into the adjacent Army floating hose area. Two LCM-6's were used to assist the SLWT. However, the sideways motion resulted in a large curve in the hoseline which required deployment of extra hose to reach the required pump site.

- The pump was deployed from a nonpowered section (Figure 3-21) with little difficulty and the hose and anchor line attached. The pump and hose were not checked for operation or pressure tested for leaks at this time.

- The towable fuel bladders were launched from nonpowered causeway sections using standard procedure.

- The OIC and AOIC were both on the same SLWT. When problems occurred, this SLWT was used to perform the task. Radio failure and a lack of daily planning reduced the involvement of the other SLWT's. Therefore, the installation of this system was pursued one event at a time rather than simultaneously.

The crew that had received the most training were from ACB ONE, but the unit supplying the equipment, causeways, and SLWT's was ACB TWO. The skilled ACB ONE personnel therefore did not operate the equipment but provided guidance to less experienced personnel.

Environment. The presence of a strong cross-current hindered installation due to the increased difficulty of controlling the craft used. A two-hour delay occurred while deploying the floating hose when the SLWT steering failed and the current tangled the Navy hoseline in the previously installed Army hoseline.

Conclusion. The capability to install the AAFSF was demonstrated. However, it required two days to install due to equipment problems, a lack of daily

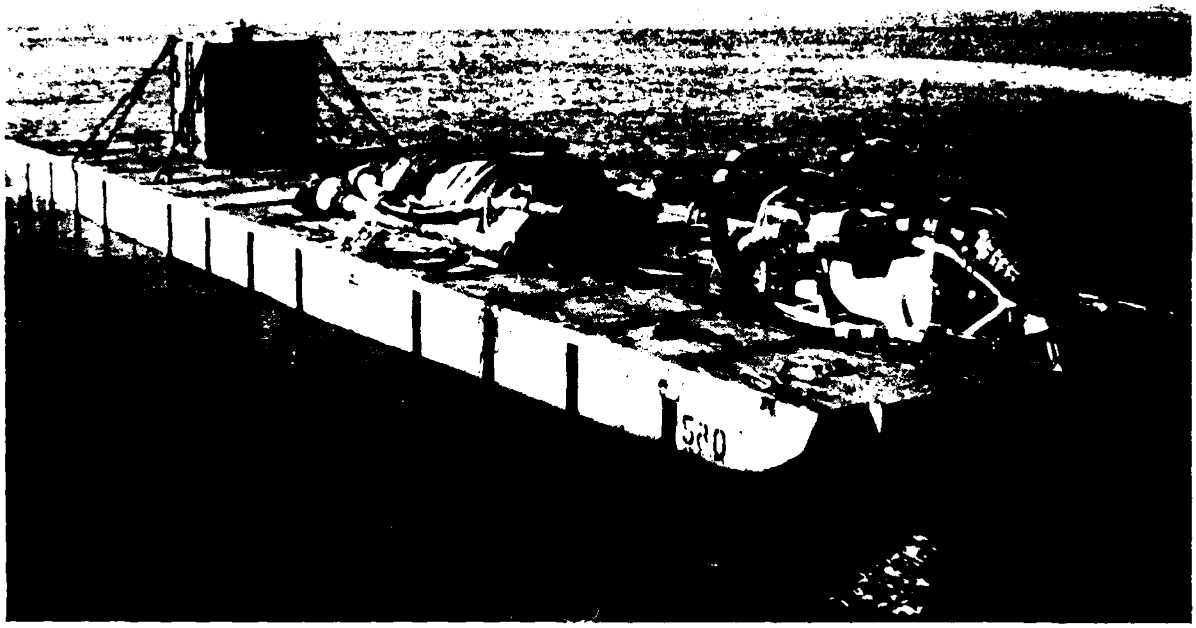


Figure 3-21 - Electric Pump and Bladder on
Nonpowered Causeway Section

planning, and frequent loss of communications which resulted in sequential rather than simultaneous operations.

The OIC should direct operations from the beach or afloat, such as from a LARC, rather than from a working SLWT. This would enable him to see the overall operation and keep all personnel working.

3.1.3.2 AAFS

The USMC unit that installed the AAFS was highly trained and motivated. Installation required 14 hr using 12 men over 2 days.

- The 7 tanks and 2 pumps installed were 1/6 of a complete AAFS.
- The front-end loader provided by an equipment company failed and delayed installation by several hours.
- The sand berms around the fabric tanks were not the full height which would have been required if fuel had been handled instead of water.
- Unfortunately, prior to commencing pumping, a storm-driven high tide forced the retrieval of the AAFS. Instead of reinstalling the seven 20,000 gal bags, the USMC borrowed 3 of the U.S. Army's 50,000 gal bags and

installed them between 2 sand dunes well back from the water's edge. No installation or interfacing problems occurred since the Marines had included adaptors to go from their 4-in. system to the Army's 6-in. system.

3.2 CARGO THROUGHPUT

This section of the report covers the discussion, analysis, and detailed conclusions of Navy/Marine Corps cargo throughput operations.

3.2.1 Container Operations

Operations involved both offloading and backloading of containers between the EXPORT LEADER and Navy lighters. Offloading and backloading was accomplished with the T-ACS between 20 and 30 September. Navy lighterage used throughout these operations included the Causeway Ferry (a mix of sizes and propulsion systems), and LCU (1600 Class).

Beach transfer systems included the Rough Terrain Container Handler (RTCH) site for Causeway Ferries and the Lightweight Amphibious Container Handler (LACH) site for LCU's. Marine Corps 5-ton tractors with M127 trailers transported containers to the marshalling yard where they were offloaded by 30-ton cranes or RTCH's.

Figure 3-22 shows the weights of containers used in the test.

3.2.1.1 Operations at T-ACS

Navy/USMC container cargo offload operations were conducted at Fort Story, Virginia, 20-24 September 1984. Container backload (retrograde) operations were then started on the 24th. Table 3-9 shows a summary of each day's activity broken down into day shifts (0800-1800) and night shifts (2000-0600) for both offload and backload. As can be seen from Table 3-9, 937 containers were offloaded in approximated 4-1/2 days while 443 were backloaded in 6 days. The major reason for the poor backload throughput was weather/sea state limitations of the various offload systems. Weather and sea state limitations resulted in the loss of about 4 of the 11 days or one third of the available test period. Sea conditions in excess of Sea State 3 were experienced only on one day. In summary, most days were Sea State 3 or below; conditions in which many of the systems being tested were expected to have operated. The following

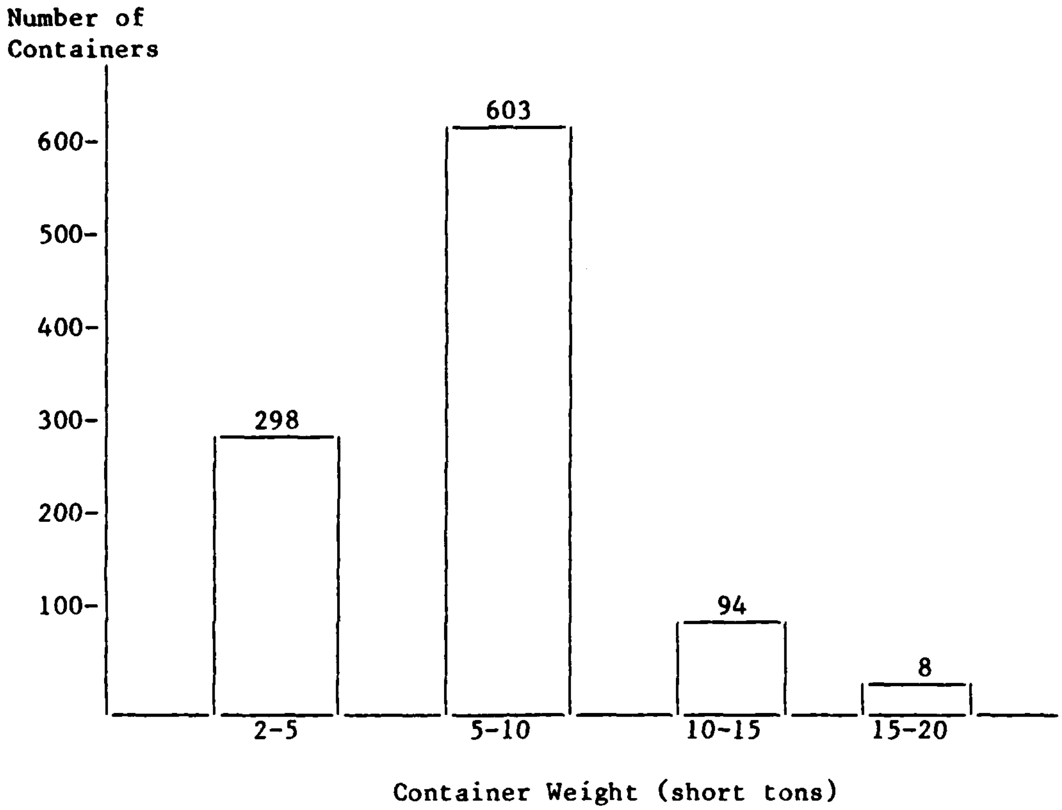


Figure 3-22 - JLOTS II Container Weight Distribution

TABLE 3-9 - NAVY/USMC CONTAINER MOVEMENT DURING THE TEST

Date	Offload			Backload		
	Dayshift	Night Shift	Total	Day Shift	Night Shift	Total
20 Sep	92	97	189	-	-	-
21 Sep	133	82	215	-	-	-
22 Sep	114	100	214	-	-	-
23 Sep	105	114	219	-	-	-
24 Sep	100	-	100	16	62	78
25 Sep	-	-		105	78	183
26 Sep	-	-		109	-	109
27 Sep	-	-		16	-	16
28 Sep	-	-		32	25	57
29 Sep	-	-		-	-	-
30 Sep	-	-		-	-	-
TOTAL	544	393	937	278	165	443

subsections include an in-depth coverage of the problems as they impacted on lighter moorings at T-ACS, lighter loadings, and lighter cast-off and clear.

Table 3-10 provides a summary of the lighters loaded during each shift and the number of containers carried by the lighter type.

TABLE 3-10 - CONTAINER OFFLOAD SUMMARY, NAVY OFFLOAD USING T-ACS

Date	Shift	Containers Offloaded	Lighters									
			P1		P2		P3		F5 & F6		LCU	
			Dep	Cont	Dep	Cont	Dep	Cont	Dep	Cont	Dep	Cont
20 Sep	Day	92	1	8	-	-	1	28	2	48	2	8
	Night	97	1	7	1	15	1	25	2	42	2	8
	TOTAL	189	2	15	1	15	2	53	4	90	4	16
21 Sep	Day	133	1	8	1	15	1	25	3	73	3	12
	Night	82	1	9	1	18	1	24	1	26	1	5
	TOTAL	215	2	17	2	33	2	49	4	99	4	17
22 Sep	Day	114	2	19	1	18	1	28	2	49	-	-
	Night	100	1	9	1	16	2	54	1	21	-	-
	TOTAL	214	3	28	2	34	3	82	3	70	-	-
23 Sep	Day	105	1	8	-	-	1	29	2	45	5	23
	Night	114	1	9	2	36	1	29	2	40	-	-
	TOTAL	219	2	17	2	36	2	58	4	85	5	23
24 Sep	Day	100	2	19	1	13	1	22	2	44	1	2
	Night	-	-	-	-	-	-	-	-	-	-	-
	TOTAL	100	2	19	1	13	1	22	2	44	1	2
CYCLE	Day	544	7	62	3	46	5	132	11	259	11	45
	Night	393	4	34	5	85	5	132	6	129	3	13
	TOTAL	937	11	96	8	131	10	264	17	388	14	58

Note: DEP = Departures
CONT = Containers
- Lighters are described in Section 3.2.1.1.1

3.2.1.1.1 Lighterage Approach and Moor

The Navy lighterage consisted of:

- P1 - CSP + 1 nonpowered section
- P2 - CSP + 2 nonpowered sections
- P3 - CSP + 3 nonpowered sections
- F5 - Two nonpowered sections plus the modular causeway section in the middle. This unit was powered by two LCM-6 tender boats.
- F6 - Three nonpowered sections powered by two LCM-6 tender boats.
- LCU's - 1600 Class Navy LCU's

There are three lighter mooring stations along the portside of T-ACS-1, each station opposite a T-ACS-1 crane location. Stations are numbered 2, 4,and 6; Station 2 being forwardmost.

Approach and mooring at the TACS started with the lighter about 100 yd from the ship and was completed when the last mooring line was secure. The longer Causeway Ferries, P2, P3, F5, and F6, when moored, occupy T-ACS-1 Stations 2 and 4 with one lighter. The P1 and LCU's are compatible with any one of the three Stations. The mooring operation itself involved a coordinated effort between the particular lighter crew and the T-ACS deck hands. In general, 2 or 3 T-ACS crewman were available to assist. Mooring lines were passed down from the main deck and secured by the lighter crew. Panama bitts (Dutch bollard) were also used by the Causeway Ferry crews to secure additional lines. The number of line handlers on the lighters varied from craft to craft but normally was in the range of 4 to 6 for Causeway Ferries and 2 to 3 for LCU's. Table 3-11 provides a summary of the actual approach and mooring test data. The sample size is very limited but does consider all available mooring test data from 20 through 26 September.

Data analysis revealed the following with respect to mooring times:

- o Mooring in daylight and at night took the same amount of time.
- o There was no apparent improvement in times as the test progressed.
- o For Causeway Ferries the times to moor at T-ACS Stations 2, 4, and 6 were about the same.

TABLE 3-11
T-ACS/NAVY LIGHTERAGE APPROACH AND MOOR TIMES

CRAFT TYPE	APPROACH AND MOORING TEST DATA SUMMARY	
	Average Time (min)	Sample Size
P1	9.5	13
P2	7.0	9
P3	12.0	11
F5	8.8	14
F6	12.6	13
LCU (1600 CL)	11.0	14

- There was no significant trend difference between P1, P2, and P3 since the approach speed and the number of mooring lines were the same.
- There was a wide span of mooring times ranging from as quickly as a few minutes up to about half an hour. Averaging the data after outliers are discarded provides the following approach and moor times per lighter type.

P1, P2, and P3 - 10 min
F5 and F6 - 11 min
LCU 1600 CL - 9 min

- Mooring a Causeway Ferry outboard of another ferry at Stations 2 and 4, as shown in Figure 3-23, worked very well and the mooring times were the same as if it moored to the ship's side. Having two ferries moored side-by-side allowed cranes 1A and 1B (on pedestal 1, opposite mooring Station 2), and 2A and 2B (on pedestal 2 opposite mooring Station 4) to continue loading containers on the inboard ferry while a

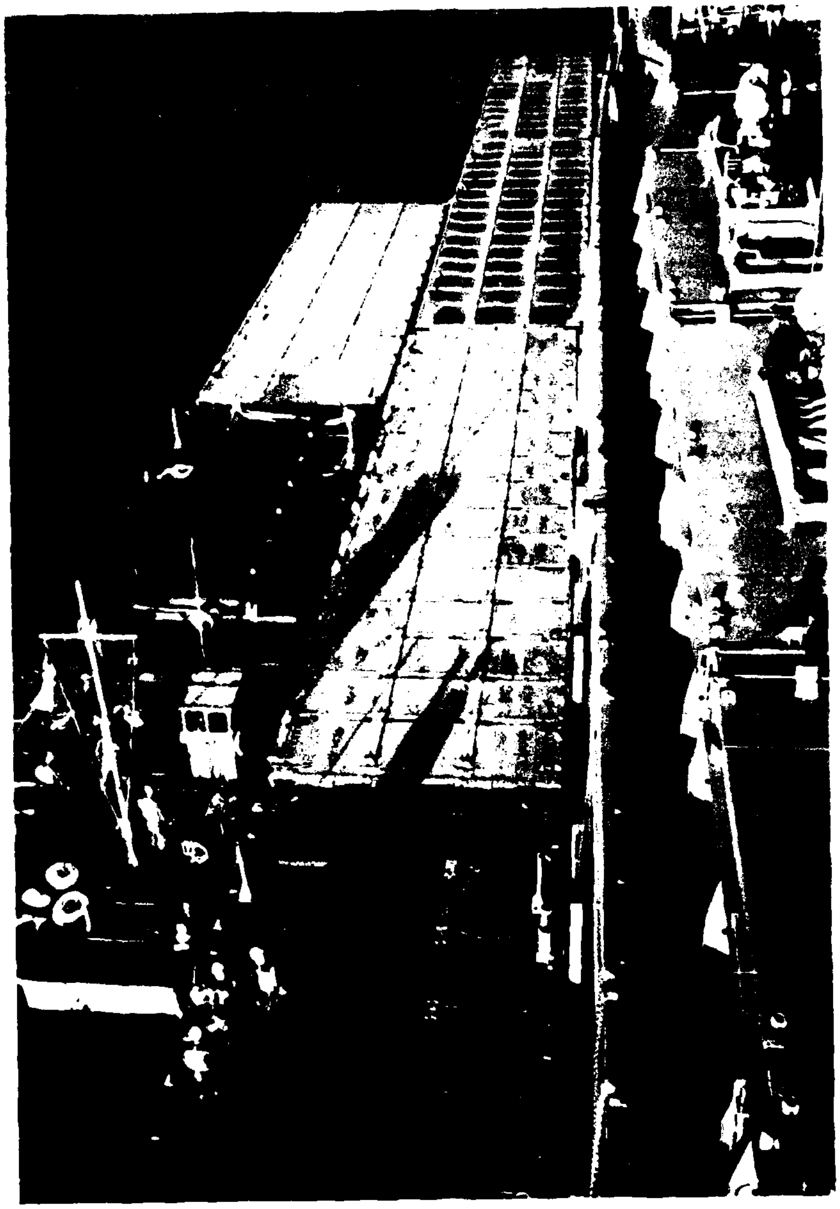
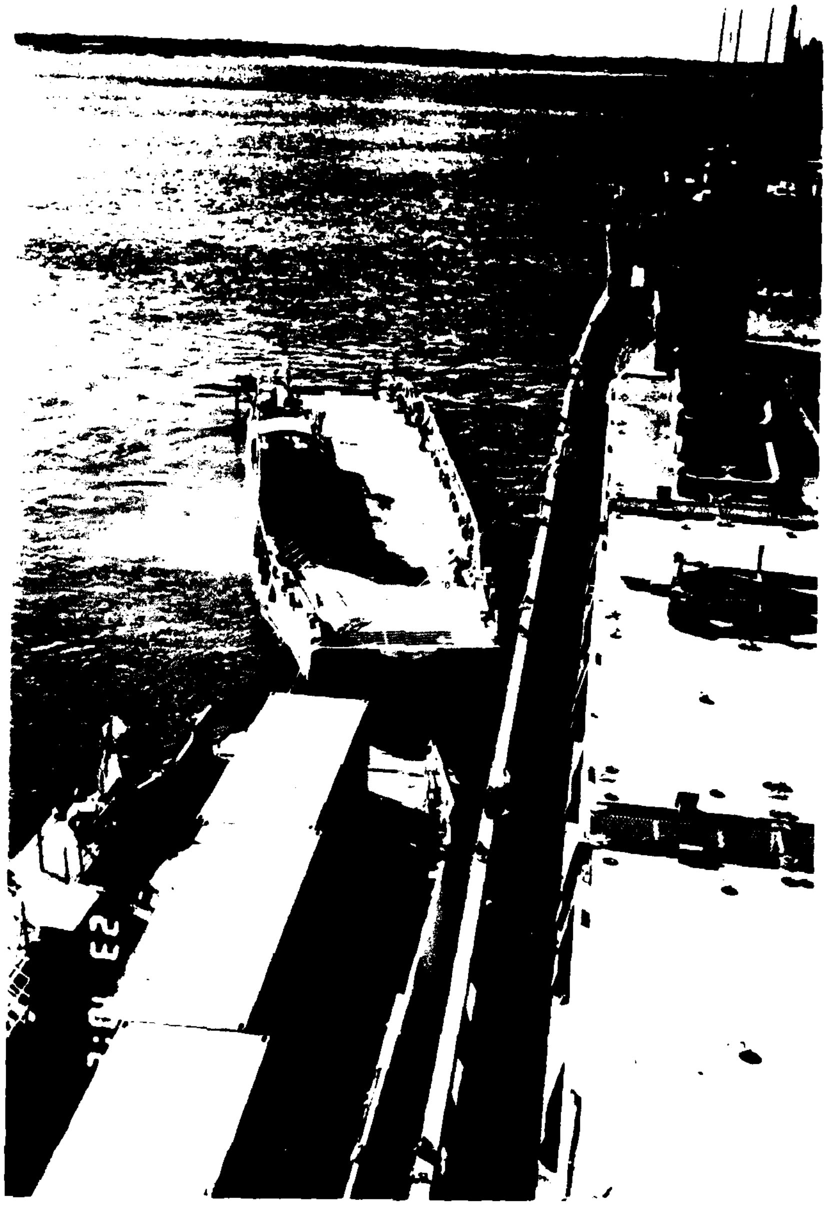


Figure 3-23 - Mooring One Causeway Ferry Outboard of Another

fully loaded outboard ferry departed and was replaced with another empty ferry (see Figure 3-24). This scheme basically eliminated most of the crane's downtime waiting for ferries to moor and cast-off.

• Valuable mooring time is lost because each ferry and LCU moors using mooring lines in different arrangements. This fact alone contributes significantly to the wide span of mooring times. Standardized procedures would improve the operation. This is especially critical in rougher sea conditions where good seamanship is essential. Regular training is needed to develop the skills to be able to work "safely" under adverse sea conditions. Figure 3-25 illustrates the precise craft control required for the LCU's as they moored facing aft, thus down current.

Figure 3-24 - Outboard Causeway Ferry Departs
While Inboard Ferry Receives Containers



(Note - Close proximity of craft and mooring line caught or LCU's bow ramp)

Figure 3-25 - LCU Starting a Chinese Moor

• Additional chocks and bulwark bitts are needed to provide mooring flexibility for different length ferries and to allow for positioning ferries forward or aft alongside, i.e., warping the ferry to allow additional cranes to load.

The H-Frames used as lighter fenders on the T-ACS were marginally adequate for all Navy lighters. The H-fenders were too short and as such, would ride up on the causeways and LCU's as shown in Figure 3-26a. In either case, the frame supporting chains parted and frames were lost overboard. A third chain was added to the frames to prevent loss of additional frames. The side of the causeways and in particular the modular causeway as shown in Figure 3-26b, continually sawed into the wood rub surfaces of the fenders. The frames should be modified and alternate fendering systems, such as a floating "sausage" system, should be investigated to augment or replace the H-Frames. One system which has merit, shown in Figure 3-27, was recently tested as part of the MPS lead ship demonstration on the merchant vessel 2ND LT JOHN P. BOBO and is similar to ELCAS fendering. This system should do well with all Navy and Army lighterage.

The sea conditions from 20 September until the afternoon of 26 September were mild, Sea State 1 or a low 2, with significant wave heights of 2-1/2 ft or less. From 26 to 30 September Sea State 3 conditions prevailed and only limited LCU backload operations were conducted on 27 and 28 September. Motion instrumentation on one of the LCU's recorded LCU significant rolls of from 1 to 5 deg and pitching in the range of 1/2 to 2 deg. Mooring operations at the T-ACS under these heavy sea conditions was difficult, requiring the exercise of good seamanship by both the boat crews and T-ACS line handlers. It became clear that under the Sea State 3 conditions encountered, the T-ACS, for the most part, could offload containers but one "weak link" was the limited capability of the Navy lighterage to moor safely.

3.2.1.1.2 T-ACS Crane Cycles and Lighter Loading

Each of the six T-ACS cranes has a 33 short-ton load capacity (below the spreader) at 121-ft outreach from the pedestal. The overall crane arrangement capacity and outreach was adequate to offload the entire containership including the removal and reinstallation of all hatch covers.

Figure 3-26 - T-ACS H-Fender Damage

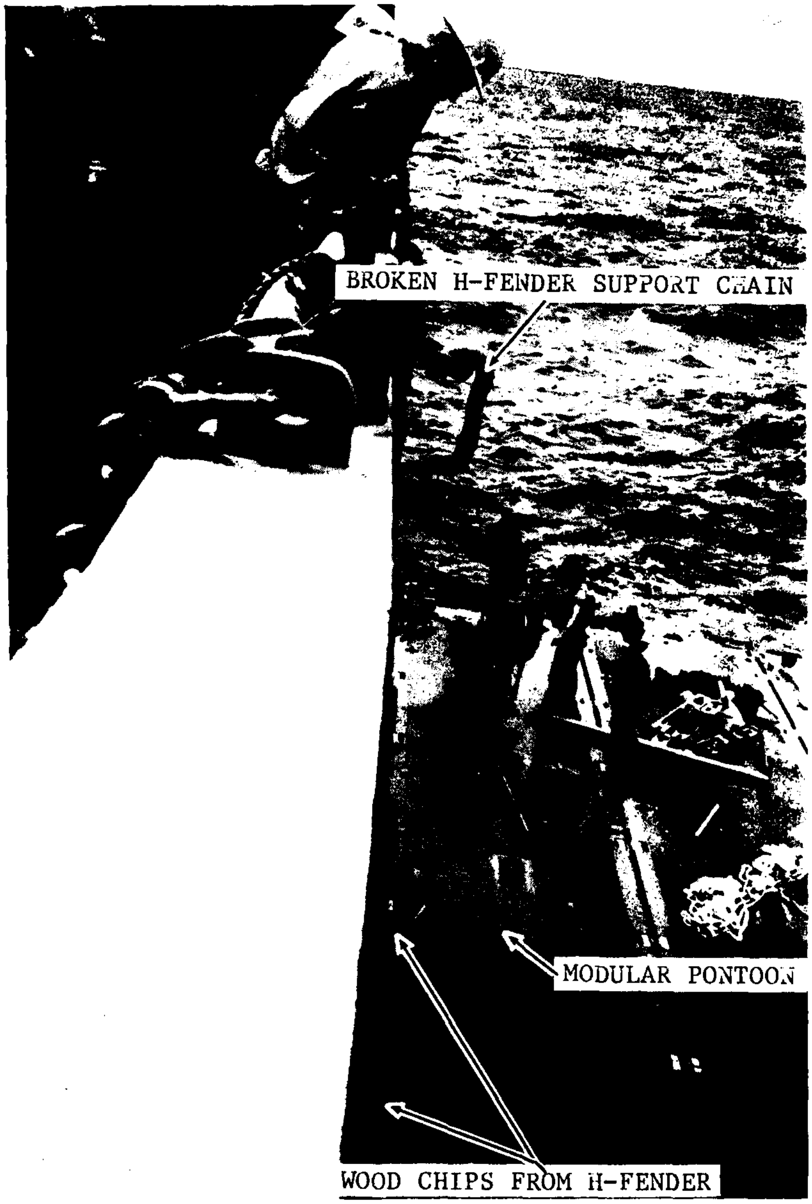


Figure 3-26 (cont) - T-ACS H-Fender Damage

Figure 3-27 - Proposed Lighterage Fendering System

The offload of the EXPORT LEADER started on 20 September with 5 cranes working similtaneously and with each crane equipped with a large automatic container spreader. Figure 3-28 shows these simultaneous crane operations. The close proximity of the cranes to each other caused crane interaction and delays where one crane would have to wait for another. Table 3-12 provides a summary of data which shows that interaction.

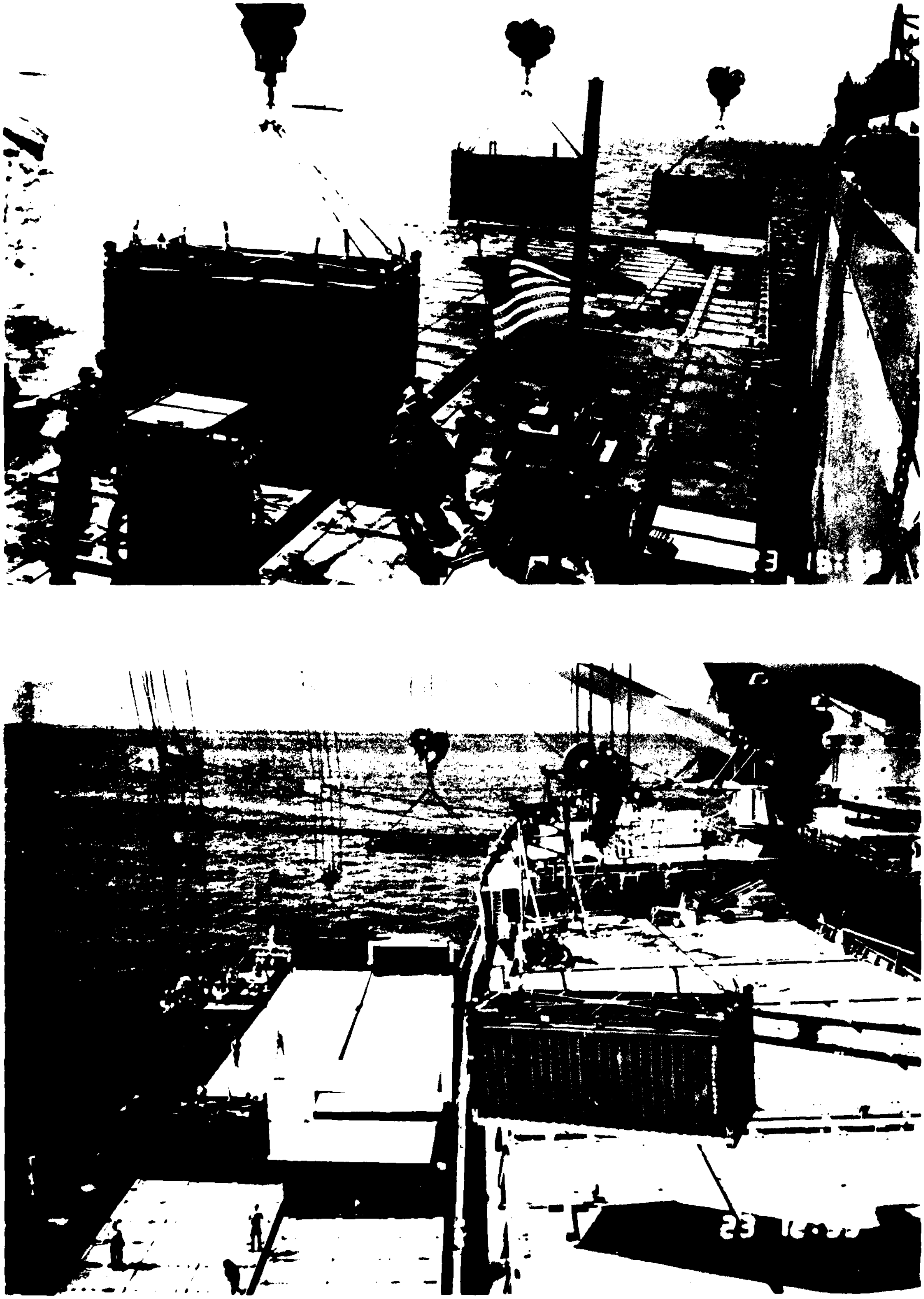


Figure 3-28 - T-ACS Crane Operations

TABLE 3-12 - T-ACS MULTIPLE CRANE LOADING RATE COMPARISON

No. of Cranes in Use	Loading Time (min)	Sample Size (No. of Cont)	Individual Crane Boom Loading Rate (min/cont)
5 Cranes -	116	33	17.6
4 Cranes -	568	142	16.0*
3 Cranes -	628	112	16.8
2 Cranes -	326	51	12.8
1 Cranes -	135	12	11.2

*Analysis did not reveal any significance to the 4-crane rate being lower than the 3-crane rate.

Crane interaction/interference with three or more cranes in operation slows each crane container loading rate by approximately 4 to 5 min/container as compared to a single crane.

The hydraulic spreader bar with powered swivel was too heavy to control with taglines, resulting in excessive pendulation. In addition, the automatic mechanisms of the spreader bar were prone to breakdown, often due to high impact from pendulation (See top view of Figure 3-29). Army owned manual spreaders were substituted and were much lighter and easier to operate. However, these spreaders had no leveling controls, which resulted in some damage to the bayonet attachments (see bottom view of Figure 3-29) on the spreader.

Data for the last 3 days of the Navy period (approximately 350 container moves during 22-24 September) were used to develop Table 3-12. Since manual container spreaders and slings were used almost exclusively during this portion of the test. They were preferred and much faster than the automatic spreaders. Figure 3-30 shows manual spreaders and slings in use.

The crane boom loading rate shown in Table 3-12 covers the time period from completion of Causeway Ferry mooring until the ferry is ready to start its departure, i.e., the time available to load the lighter. It

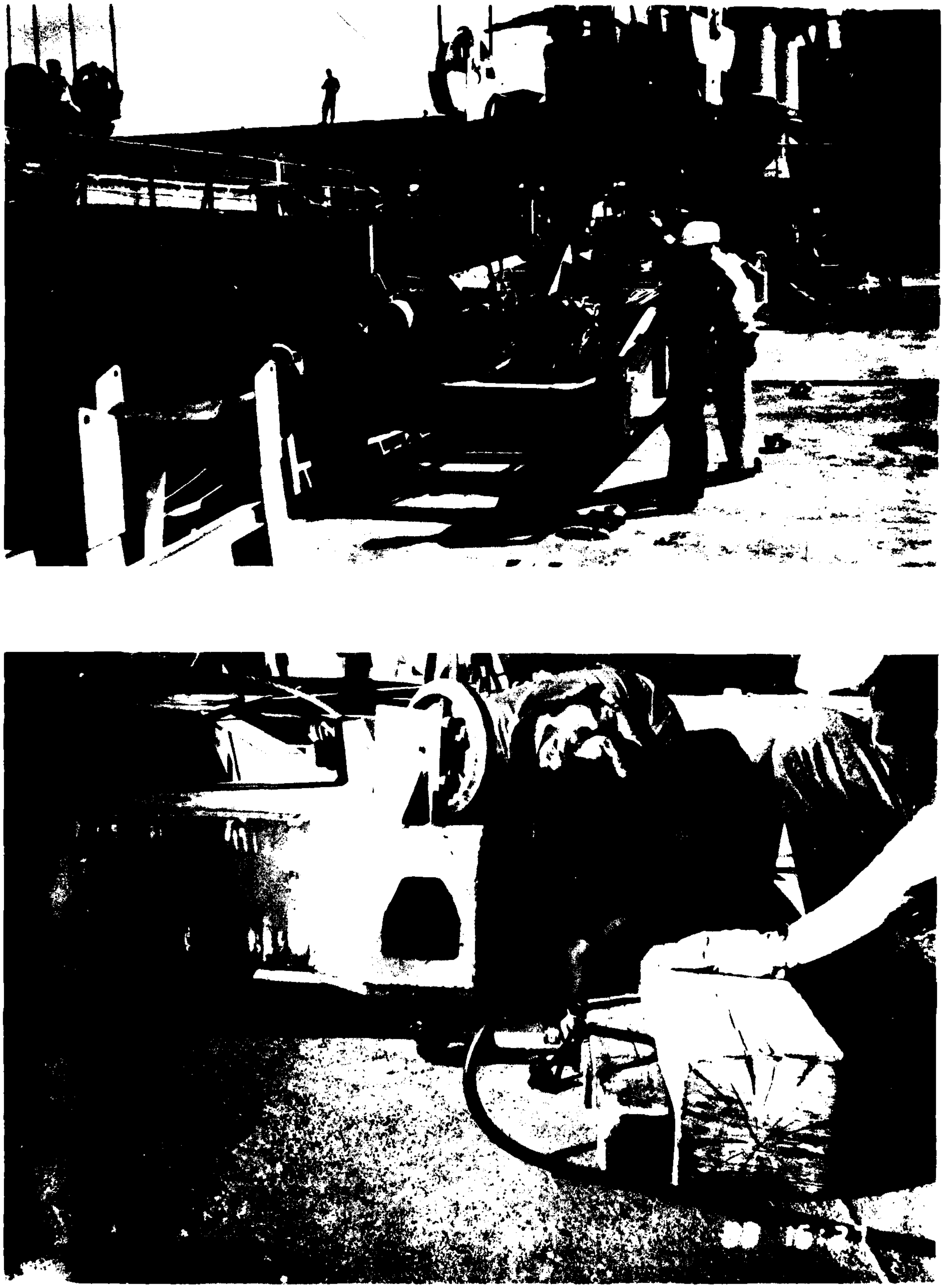
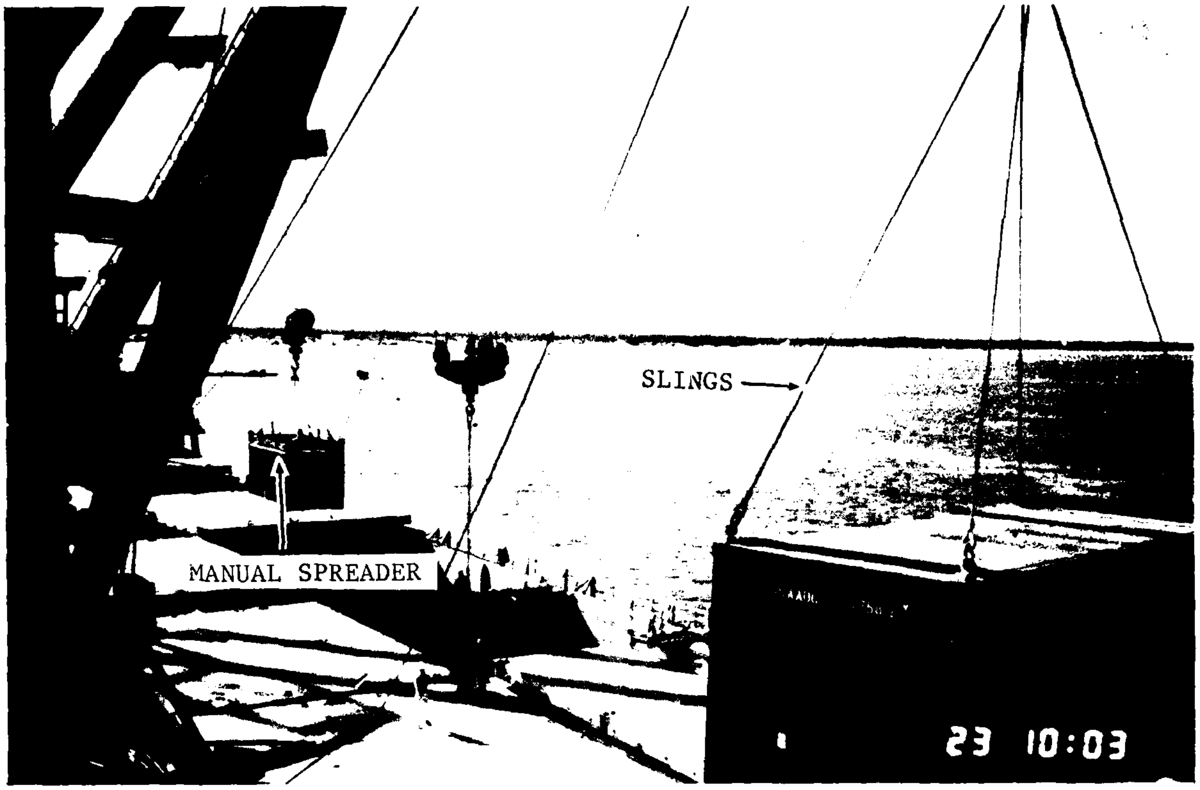


Figure 3-29 - Automatic and Manual Container Spreader Bars



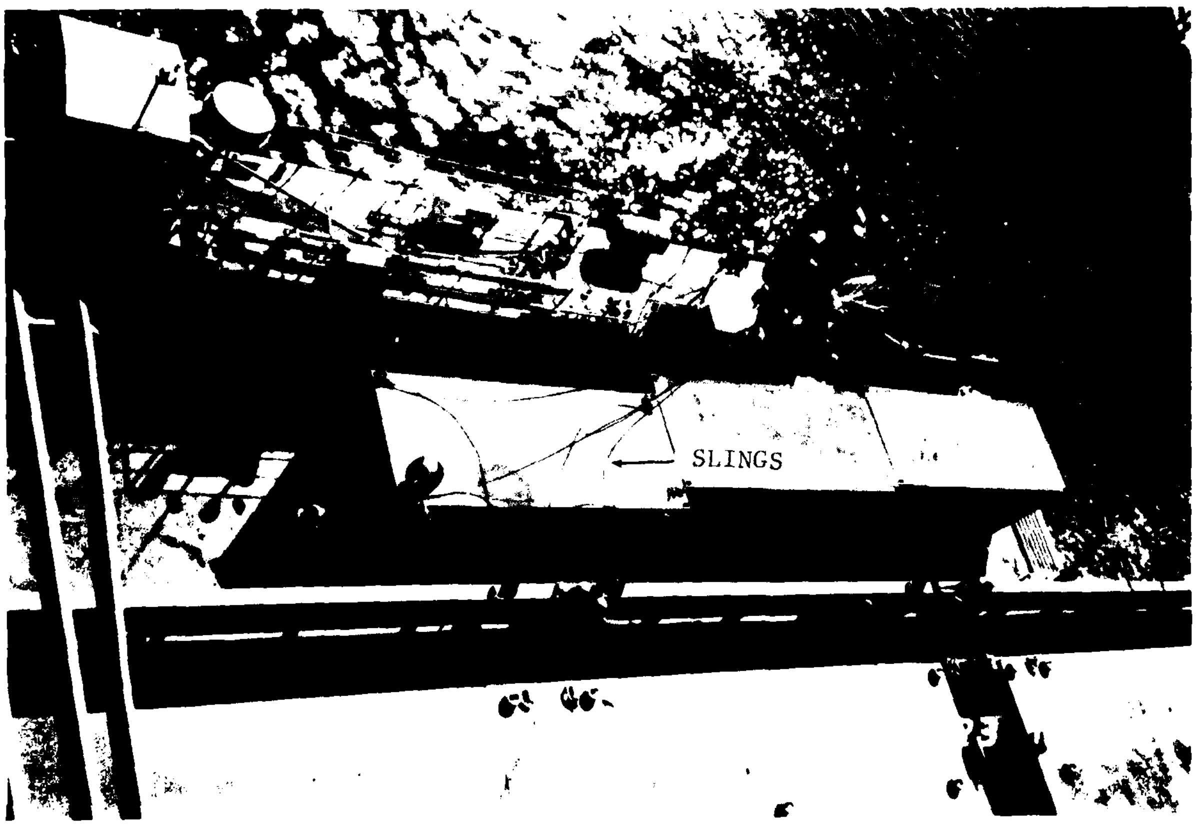


Figure 3-30 - Container Slings in Use

should be noted that these rates only apply to Causeway Ferries. An overall average rate of 16 min/boom for each crane was developed based on the assumption that the vast majority of Causeway Ferry loading would involve multiple cranes working simultaneously to load the ferries.

Loading rate of 11 single Causeway Ferries were compared to the rates of 6 sets of 2 ferries each moored side-by-side during 22-24 September. Table 3-13 provides actual lighterage data which is summarized in Table 3-14. The loading rate of a set of two Causeway Ferries when moored

TABLE 3-13
CAUSEWAY FERRY AND LCU LOADING RATE DATA

Lighter	Sample Load Time (min)	Total No. of Containers in Sample	T-ACS Loading Rate (min/cont)	No. of Cranes Used to Load	Individual Crane Boom Loading Rate (min/boom)
F5	46	11	4.2	3	13
F5	110	22	5.0	4	20
F5	45	8	5.6	4	22
F5	99	16	6.2	4	25
F5	181	16	11.3	2	23
F6	71	12	5.9	2	12
P1	73	7	10.4	1	10
P3	100	17	5.8	3	18
P3	70	13	5.3	3	16
P3	111	29	3.7	4	15
P3	56	10	5.6	3	17
P1 + F6	67	14	4.8	3	14
P2 + P1	52	17	3.1	4	12
P3 + F6	151	50	3.0	4	12
P3 + P1	59	10	5.9	2	12
P2 + F6	145	24	6.0	3	18
F5 + P3	111	18	6.2	3	19
LCU 1644	41	4	10.2	2	20
LCU 1663	40	5	8.0	2	16
LCU 1661	62	5	12.4	1	12
LCU 1657	27	4	6.8	2	14

TABLE 3-14
CAUSEWAY FERRY LOADING RATE COMPARISON

Causeway Ferry Mooring Arrangement	Sample Size (No. of Containers)	Individual Crane Boom Loading Rate (min/cont)
Single Ferries	161	17.7
Sets of 2 Ferries Moored Side-By-Side	133	14.3

next to each other was faster than a single Causeway Ferry by approximately 3 min/container per crane boom. This was because each crane had empty lighterage deck space available for containers and therefore could continue working when one of the lighters was temporarily unable to receive a container. The outboard Causeway Ferries were loaded first, until a given crane ran out of container space on that ferry. At that time, the crane would load the inboard ferry. Therefore, the inboard ferry acted as a buffer and remained alongside T-ACS, in some cases in excess of six hr. The real payoff for this technique came from the fact that the cranes could continue working while an outboard ferry was leaving and being replaced by an empty ferry.

The number of containers loaded on a particular lighter type varied. For example, P3 carried as few as 22 containers and on one load carried 30 containers. The container load varied for all the lighter types and is summarized in Table 3-15. Table 3-15 also provides the average container load per lighter type. P3 averaged the most containers carried per load, 26.4, while the 1600 Class LCU had the fewest, 4.3. It is important to recognize that maximum throughput rates can only be achieved when all possible T-ACS cranes are moving containers. If 3 cranes are idle, waiting for a single boom to finish a maximum container loadout, then this slows throughput. It is more productive to order the partially loaded ferry to the beach so that another empty one can come alongside to enable maximum crane utilization.

There were a few instances in which cranes double handled containers by placing them on the T-ACS hatch covers. This was done as an attempt to expedite the operation in cases where there was no space available on a

TABLE 3-15 - AVERAGE CONTAINER LOAD PER NAVY LIGHTER

Lighter Type	Range of Containers Carried	Average Container Load
P1	7 to 10	8.7
P2	13 to 18	16.4
P3	22 to 30	26.4
F5	22 to 29	25.6
F6	15 to 23	20.1
LCU 1600 Class	3 to 5	4.3

lighter for additional containers. Only 65 containers were double handled during the Navy offload. This technique did reduce the effective crane cycle time between 2 to 6 min for those few containers shifted to the T-ACS deck. However, the overall impact on reducing the total ship offload time was minimal, i.e., approximately 1-1/2 hr since, for the most part, Causeway Ferries moored side-by-side allowed for almost continual container loading.

LCU container loading during the Navy test was very limited and data taken from 20-21 September was of questionable quality, therefore it was not used for the development of planning factors. LCU's were not used at all on 22 and 24 September. On 23 September, only four LCU trips were made and these are summarized in Table 3-13. As a result of the limited LCU data available during the Navy period, Army LCU data has been used as discussed in the Army portion of this report.

Manpower used on the T-ACS was directly related to the number of cranes being operated at any one time. This varied from 5 cranes at the beginning of the offload to 1 crane at the end. A typical crew per crane was as follows:

Function/Unit	Quantity
Crane Operator/T-ACS	1
T-ACS Crane Signalman/T-ACS	1
Container Ship Crane Signalman/ NAVCHAPGRU	1
Container Ship Hatch Gang/NAVCHAPGRU	3 or 4
Boat Jumpers/NAVCHAPGRU	1 or 2

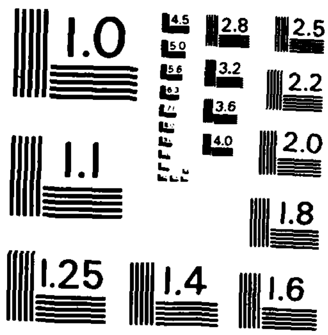
Overall there were sufficient personnel, both military and civilian, to offload the containership with minimal delays. As would be expected, there were communication problems between the various units involved, but this became less of a problem as the test progressed. The most significant area of communication difficulty was between the crane operators and the signalman on the containership. There were numerous occasions where improper crane signals were given and where the crane operators would ignore the signals which were given. The crane operator/signalman interface is critical to achieve rapid and safe throughput. Improved operations could be achieved if these individuals were in the same command and received the same basic training on T-ACS crane/RBTS controls and operation. Consideration should be given to having the NAVCHAPGRU responsible for T-ACS crane operator and signalman functions. In any case, better communication and training between signalman and crane operations is needed which emphasizes operation in rough seas.

Boat jumpers were used to help position containers on the lighter and then disconnect the container lifting apparatus. Lighter crews, as the test progressed, started to assist and, in many cases, performed these functions. The procedure for using boat jumpers was not consistent and, in hindsight, should be questioned. Lighter crews, with proper training, could easily perform these duties without an increase to the crew complement.

Examination of 127 container cycles for Causeway Ferries has shown that the average time for the portion of a T-ACS crane cycle starting from when the container is over the lighter until it is actually placed and properly positioned on the lighters deck was approximately 4 min. Data taken from 20-22 September was not used since precise container positioning

AD-A160 600 JOINT TEST DIRECTOR JOINT LOGISTICS OVER-THE-SHORE II 3/5
TEST AND EVALUATION..(U) NAVAL AMPHIBIOUS BASE LITTLE
CREEK NORFOLK VA AUG 85

UNCLASSIFIED F/G 15/5 NL



MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

on Causeway Ferries was directed during these first few days until it was determined by the operators that precise, i.e., "exact" container positioning was not required. It should be noted that even though positioning improved during the test, much greater improvement and time savings could be achieved. There is limited deck space since a 20-ft container is being placed on a causeway deck 21-ft wide but, repeatedly, containers were repositioned 3 or 4 times to try to get it "better". Procedure guidance is needed so that only the necessary positioning is required. The causeway deck could be painted to indicate the acceptable loading positions. The container positioning problems on Causeway Ferries slowed the operations considerably since approximately 25 percent of a typical crane cycle time was spent trying to gain precise position on the Causeway Ferry. In addition, each Causeway Ferry crew had their own opinion, which caused additional confusion for the T-ACS signalmen and crane operators.

Following are some additional results of the complete analysis of crane boom cycle rates and evaluation observations:

- Crane operator skill, or lack thereof, has a significant impact on overall lighterage loading rates.

- The most time consuming portion was attaching spreader bars to the container. This became more difficult and time consuming the further down the container was in the holds of the EXPORT LEADER. For the most part, if the crane operator could see the container, the securing time was less. Use of the remote control console for the cranes, in its current arrangement, aboard the containership is not practical because of the limited cable length, and because the operator could not then see the lighter.

- Use of slings was the fastest most productive method tested. This was substantiated during portions of the Army operations when slings were used almost exclusively.

- Individual hatch cover moves took from about 1/2 hr up to 2 hr (see Figure 3-31).

- As the containership was emptied, containers were no longer available to all cranes. In the case of the EXPORT LEADER, the cells serviced by the aft crane booms were those aft of the aft deckhouse and contained a total of only 56 containers. These booms were idle following the offload of those containers.

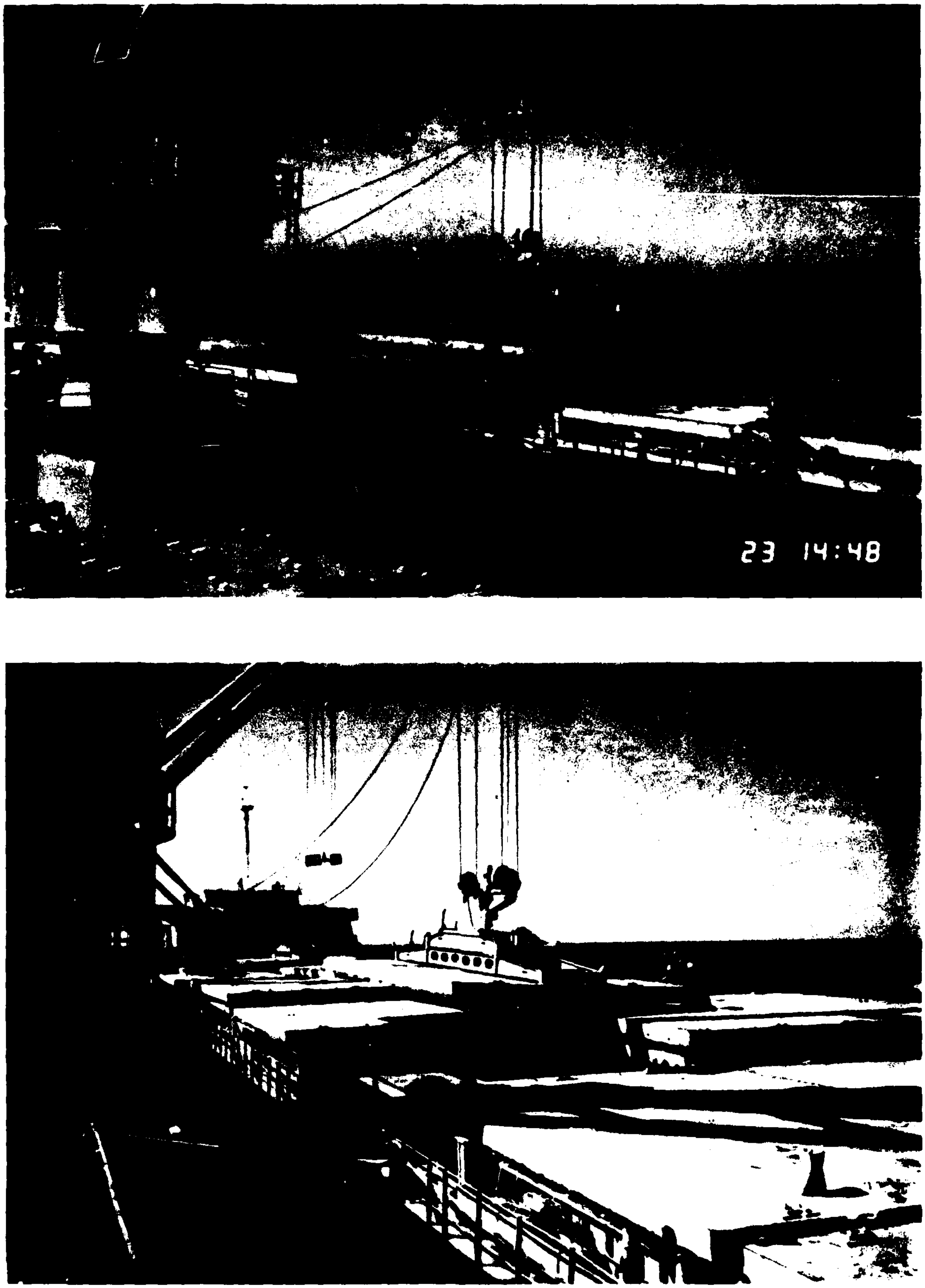


Figure 3-31 - Moving Hatch Covers

- The automatic spreader bars were too heavy to control by hand-held taglines and were prone to breakdown. Manual spreader bars and cable slings were more effective.

- The T-ACS crane and RBTS, as tested in JLOTS II, could not operate under conditions of minor sea induced roll. With as little as one degree of T-ACS roll, pendulation could not be controlled. The small ground swells experienced at Fort Story were much milder than conditions that might be expected elsewhere. T-ACS cranes and RBTS redesign is necessary, to provide effective pendulation control with the T-ACS rolling as much as five degrees (single amplitude). Section 3.2.1.1.4 of this report contains additional information on this subject.

3.2.1.1.3 Lighter Cast-Off and Clear

Cast-off and clear at the T-ACS starts when the last container is loaded and is complete when the lighter is clear of the ship's side such that another lighter may start its approach. Table 3-16 provides a summary of the actual Navy cast-off and clear test data collected from 20 through 26 September.

Data analysis revealed the following with respect to cast-off and clearing operations:

- As with the moorings, there was no apparent improvement in times as the test progressed.

- As shown in Table 3-16, the times increase as the length of Causeway Ferry increases. The primary reason for this is the increasing payload carried on P2 and P3 with identical propulsion systems. In addition, it takes longer for the line handlers to get to the craft's mooring bitts. They either had to climb over or slowly work their way around (i.e 20-ft wide container on a 21-ft wide causeway) the containers to get to the mooring bitts to release the lines.

- Night operations tend to be more time consuming than day operations for P2 and P3. This is probably caused because of increased difficulty with communications on the longer ferries.

- Night operations tend to be more time consuming than day operations for F6. This is probably caused because of increased difficulty with communications between the tender boats crews and the line handlers.

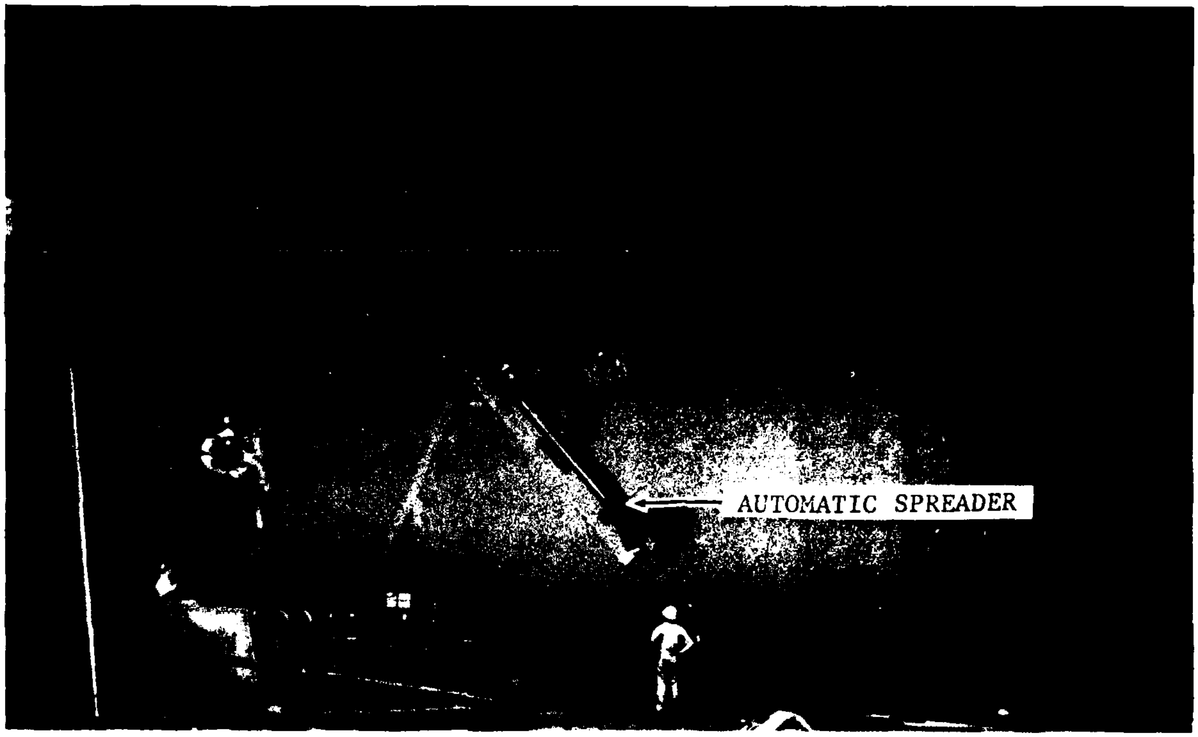
TABLE 3-16 - T-ACS/NAVY LIGHTERAGE CAST-OFF AND CLEAR TIME

Craft Type	Cast-Off and Clear Test Data Summary	
	Average Time (min)	Sample Size
P1	8.4	10
P2	14.0	7
P3	18.5	8
F5	7.9	9
F6	15.0	10
LCU (1600 CL)	5.7	14

- The departure time of the Causeway Ferry with the modular section (F5) is faster than that of the conventional ferry (F6). This is due to the increased deck space available on the modular causeway which facilitates rapid access to and removal of the mooring lines. The line handlers did not have to climb over the containers to get to the mooring bitts.
- When two Causeway Ferries were moored next to each other the outboard ferry, once loaded, could disconnect and clear the area without causing any delay time to the cranes.

3.2.1.1.4 Sea State 3, Ground Swells, and Load Pendulation

The T-ACS demonstrated the capability to move containers in Sea State 3 as long as the sea conditions consisted of small period waves, i.e., wave/chop rather than long period ground swells. Navy lighterage did not demonstrate a Sea State 3 capability. Whenever the T-ACS became exposed to ground swells on her beam she would begin to roll slightly, about 1 deg, which induced spreader bar pendulation as shown in Figure 3-32. The Rider Block Tagline System on T-ACS was not effective in controling this pendulation. The controls for the Rider Block Tagline



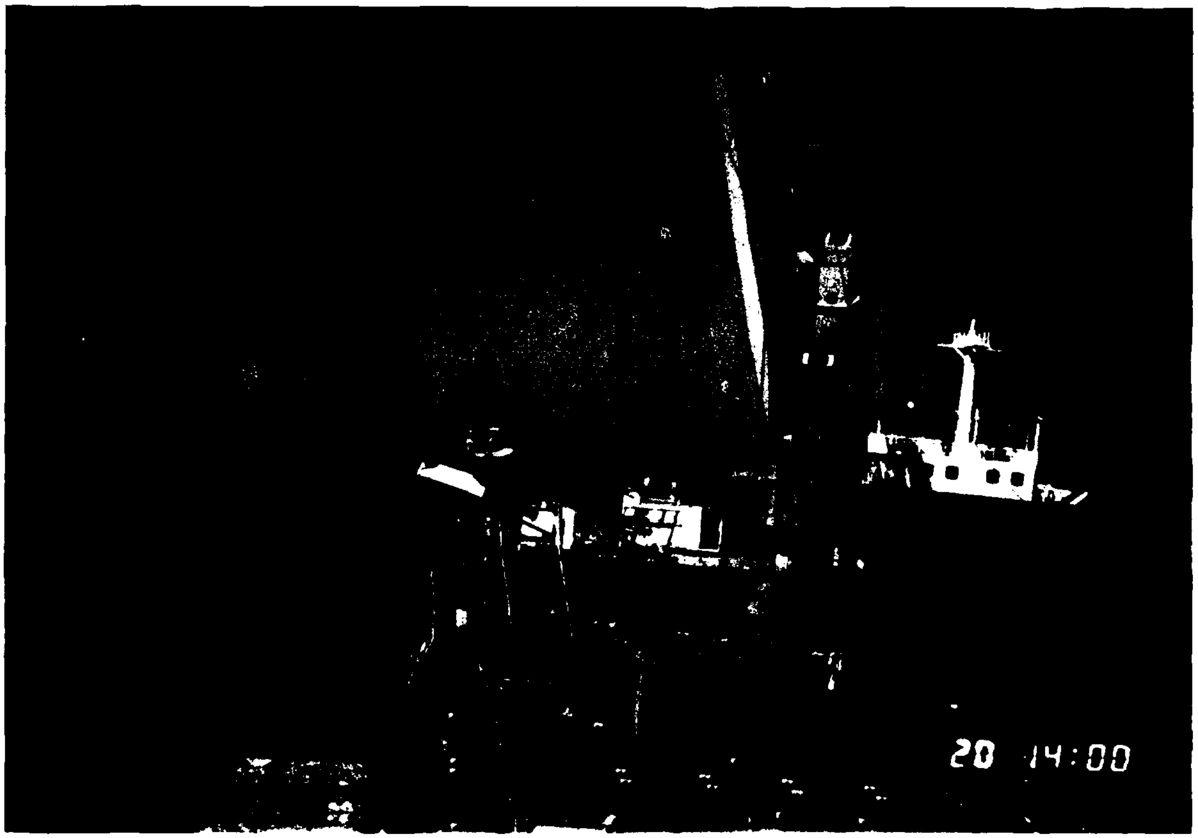


Figure 3-32 - Pendulation Problems on T-ACS

Systems are difficult to use and have an unacceptable time lag of 6 sec in transitioning from raising the rider block to tensioning the taglines. They were so difficult to use that most of the crane operators refused to use them. Ironically, when they were used, they made a bad situation worse. The only times that they were used was when the containers started large pendulations. When the rider block was lowered to try to control the pendulation, the pendulation became more abrupt and caused dangerous jerks in the tagline system. The rider block control system was an "add-on" to the normal crane controls. As such, the crane/RBTS are not integrated and lack the control characteristics and functions needed for the operator to control the hook at all times so that load pendulation cannot start.

Figure 3-32 illustrates the problems encountered when using massive/ heavy rigging gear coupled with an ineffective tagline system. A hydraulic spreader was hanging free and started pendulating. When the rider block was used to try to control the pendulation, the spreader rotated up to 80 deg from the horizontal from jerks in the tagline. On other occasions pendulation occurred with the entire crane hoist cables, rider block, hook assembly, and spreader swinging out of control across the ship's beam. Figure 3-32 also illustrate this problem.

Crane operator inexperience was another factor which added to the pendulation problems and resulting test delays. Able-bodied Seamen (AB's) with little or no crane operator experience were hired to operate the highly sophisticated T-ACS cranes in the dynamic environment of an open seaway. The four-month training program, established for the operators, did not prove sufficient.

The rider block concept has been used with success on other crane applications. Ship tests were conducted in 1980 off the California coast with both the crane ship and containership rolling in excess of 5 deg. These 1980 tests clearly show that the RBTS is essential in offloading containerships. The following conclusion from the test report[9] are provided:

"The motions experienced by the USS CABILDO (crane ship) made the ability to control the loads without the RBTS difficult and unsafe to the point that the decision was made not to attempt bare-crane operations."

"Container handling operations were conducted (with the RBTS) with the CABILDO (crane ship) roll motions of up to ± 6 deg and the SS LINCOLN (container ship) roll motions of up to $\pm$ 10 deg."

It is essential that the T-ACS cranes/RBTS be redesigned to provide effective pendulation control during crane ship roll motion of as much as 5 deg (single amplitude). It should also be noted that the overly complex, massive, and heavy hook power swivel assembly, rider block, and automatic spreader increased the difficulty for the crane operator to control pendulation. As shown in Table 3-17, the weight of the rider block, hook power swivel assembly and automatic spreaders is 22,900 lb. This weight represents only the lifting apparatus, not the container. Simpler lighter components should be considered such as:

• Small rider block and hoist sheave used on Army TCDF	1200 lb
• Conventional light weight swivel hook	1600 lb
• Container slings and light weight strongback	300 lb
TOTAL	3100 lb

TABLE 3-17 - T-ACS CRANE RIDER BLOCK HOOK, POWER SWIVEL ASSEMBLY, AND CONTAINER SPREADERS WEIGHT

Item	Weight (Lb)
Rider Block	4,100
Hook Power Swivel Assembly	5,400
Container Spreader System (20-Ft & 40-Ft Combination)	13,400
TOTAL	22,900

It is recommended that crane operators for the T-ACS be obtained from a labor market of experienced marine crane operators - either civilian or military. This experience must include instream crane operations where ship rolling occurs so that the operator can develop proficiency in controlling load pendulation. Use of military crane operators from the same units as the military stevedores (signalmen, tagline handlers, hatch crew, etc.) would serve to minimize interface problems that occur when two

units man the same operation. These interface problems were particularly apparent in the civilian T-ACS crew/military stevedore interface experienced during JLOTS II.

It is dangerous to conduct lighter container offloading operations on the windward side in Sea State 3. The wave conditions on the windward side are highly confused with incident waves adding to reflected waves from the ships. Lighter rolls in excess of 5 deg were observed with occasional lateral jolts when the lighter would hit the fenders on the side of the T-ACS. These motions were dangerous to the personnel working with the containers. In contrast, operations were easily performed on the leeward side only 1-1/2 hr later in the same general sea conditions. The single anchor system for T-ACS and the containership allows swinging of the ships to create a windward side situation up to half of the day. A two-point mooring system should be studied. If it is a feasible addition, two-point mooring would have two advantages:

1. It would prevent the ship from coming broadside to prevailing ground swells and thereby minimize ship motion-induced pendulation. This is pendulation occurring when the container is 50- to 60-ft below the RBTS. Such a condition exists when working in deep holds of a containership and over the T-ACS port side forward.

2. It would create a permanent lee on the port side of the T-ACS ship to facilitate lighter operations at the ship in Sea State 3.

The complexity and expense of such a two-point mooring system could be minimized by designing the system to a Sea State 3 holding capacity. When sea conditions exceed Sea State 3, operations will cease for other reasons, and the stern mooring can be retrieved or slipped until the weather subsides and operations resume. Systems that might be considered include a stern anchor from the T-ACS or the Navy Propellant Embedment Anchor (PEA) deployed using SLWT's

During the Navy period, operations were canceled on 26-30 September, except for a few containers backloaded by LCU's on 27 and 28 September. Figure 3-33 shows that Sea State 3 conditions existed during most of this period with significant wave heights between 3.5 and 5 ft. Operations were canceled because of safety considerations based on Surf Observations (SUROB) reports developed by the Beachmaster Unit (BMU) Detachment in accordance with OPORDER JLOTS II-1-84 (CNSL/CNSP Inst 3840.1S Joint Surf

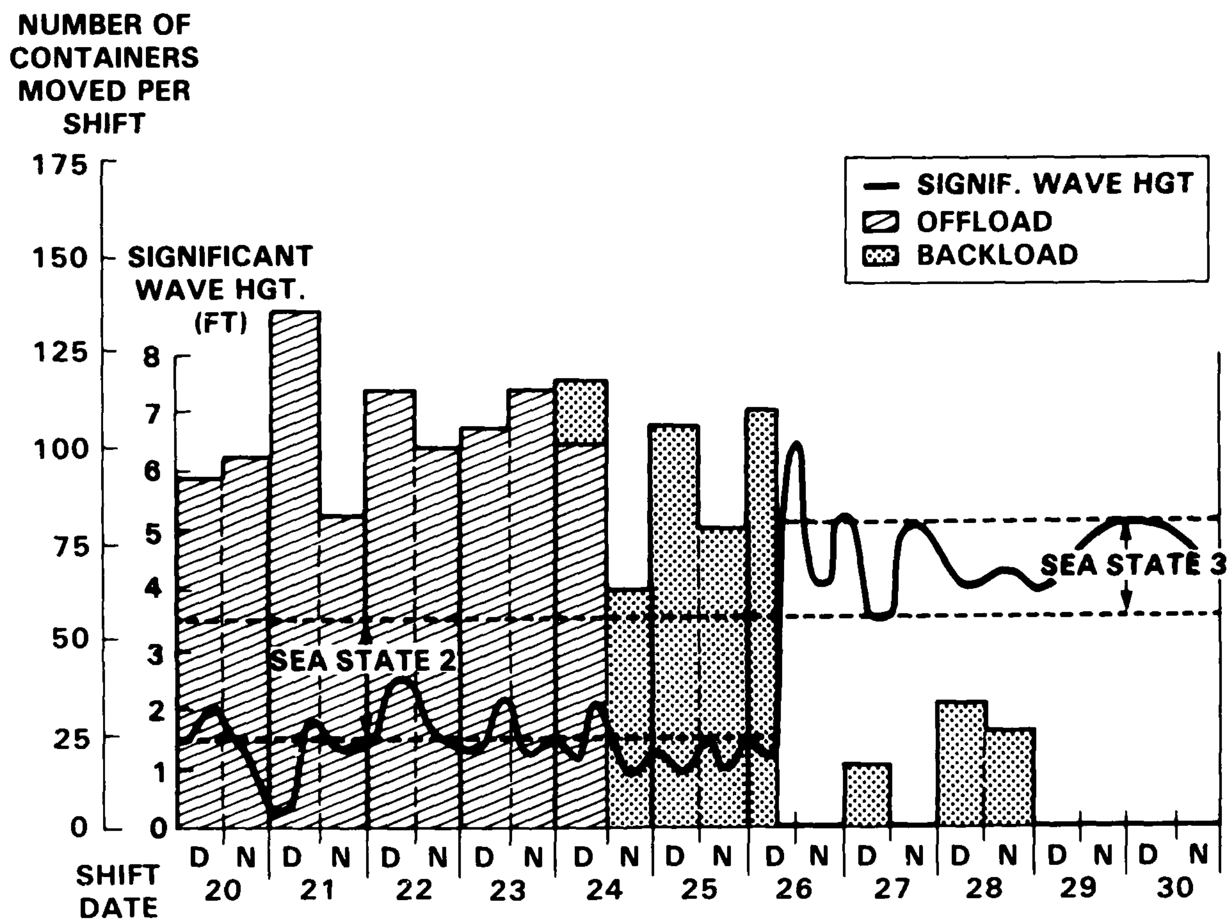


Figure 3-33 - Navy/T-ACS Operations - September 1984

Manual). The OPORDER provided the following criteria for determining when operations should be canceled:

"The effective surf height is the maximum that should be attempted for routine operations. If the effective surf exceeds the maximum surf capability of the craft, the use of the craft will be halted immediately by the CATF Watch Officer (or PCS Watch Officer in his temporary absence from CIC) and reported to CATF and Joint Test Director. The conduct of the JLOTS evaluation is not so important that any craft or personnel should be endangered attempting a landing under unsafe surf conditions."

"Maximum Surf Capabilities"

Craft	Maximum Surf Capacity
LCVP/GIG/LCPL	4
Causeway Ferry	6
LCM-6	6
LCM-8	7
LARC-V	9
LCU	10

A thorough review and update of the Joint Surf Manual is recommended which considers the following:

- The fact that the ELCAS pierhead is beyond the breakers which should enable shore unloading in rough conditions where beaching would be risky.
- Equipment/system improvements made to the T-ACS as a result of the lessons learned during JLOTS II i.e., improved pendulation control, working on the lee side, etc.

During 26-30 September, it became clear that the demonstrated Navy's personnel transfer capability was lacking. Personnel could not be transferred safely in the following applications:

1. Lighter-to-lighter for boat jumper duties
2. LPD-1-to/from-lighter for administrative personnel transfer
3. T-ACS-1-to/from-lighter for stevedore and data collector shift changes.

Personnel transfer using LCM-6's is limited to calm conditions. LCU's were not allowed to come alongside the LPD because they could damage the accommodation ladder. An Army LARC-LX was used during those Sea State 3 periods to move operating personnel from the KEYSTONE STATE and CAPE ANN to the beach and back, but was not allowed to come alongside the LPD. The well deck could not be used for LCU's since it was filled with LCM-6's as shown in Figure 3-34. A Jacobs Ladder from the LPD's side port was not

Figure 3-34 - LCM-6's Filling Well Deck

used because of safety concerns. Key operational command personnel were also stranded on the beach unable to get to the command ship, and approximately 30 people were also stranded on the LPD for three days.

It would appear that we have a "Catch 22" situation where during rough seas LCU's can move containers, but Navy boats and shipboard personnel offloading systems are not safe for handling personnel. It is recommended that safe personnel transfer systems be developed and tested. In addition, since LCM-6's are limited to operations in calm seas, they should not be involved in LOTS Operations.

3.2.1.1.5 Proposed T-ACS Modifications

Observations from the designated general observers, military operators, ship's force, and on-site technical representatives were solicited and collected throughout the entire test period. All of these observations have been reviewed and evaluated.

The preceding sections as well as the Army section of this report discusses particular problems within the various functions that the T-ACS

is required to perform. The following list pulls together all the proposed T-ACS modifications and serves as a summary to facilitate the planning of action needed:

- Eliminate the overly complex and heavy hydraulic automatic spreaders. Replace with both lightweight manually operated spreaders and appropriate strongback sling devices as conceptually shown in Figure 3-35. The strongback sling device must be designed to comply with the applicable engineering standard "Requirements for Closed Van Cargo Containers" (ANSI MH5.1.1-1979) which states "7.3.2 -Lifting by top corner fittings. Containers are subject to being lifted by the top corner fittings with lifting forces applied vertically by use of hooks, shackles, and twist locks or equivalent means. The lifting device must be maintained in the vertical direction." Compliance with this ANSI requirement will ensure that the top of the containers are not damaged by introducing excessive compressive loads. In addition, the corner fittings on the slings used had a tendency to work loose before a lift was actually made. This required the reinstallation and careful visual inspection to ensure all four fittings were properly positioned. The fittings need a positive locking mechanism to prevent them from disengaging. The slings used during the test did not have a capability to level a container which was improperly loaded.

- Eliminate each crane's electrical umbilical cable and replace the massive hook assemblies with a small swivel hook similar to the P&H 140-ton crane used on the DeLong Pier. Section 3.2.1.1.4 provides additional data. This will require rigging modifications at the boom tip to bring the sheaves closer together.

- Redesign and reduce the overall size and weight of the rider block assembly. The rider block and hook block should be as compact and light as possible. See Section 3.2.1.1.4 for additional details. The rider block used by the Army TCDF should be considered for T-ACS application since its weight was only 30% of the T-ACS rider block assembly.

- The T-ACS crane and Rider Block Tagline System (RBTS) should be redesigned to incorporate the following features:

  (1) Integrate the crane and RBTS controls to enable simultaneous operations of:

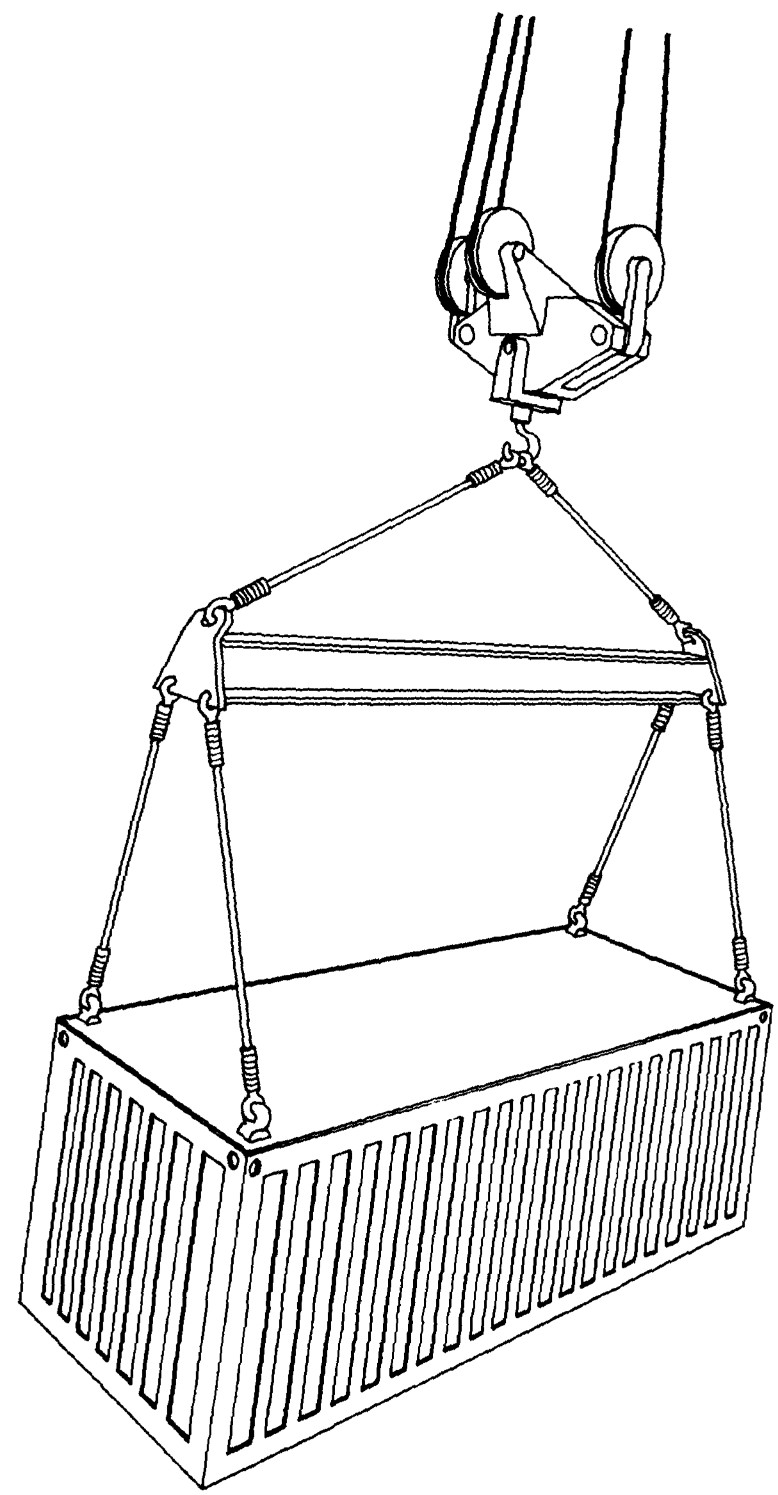


Figure 3-35 - Proposed T-ACS Strongback/Sling Container Lifting Device

- Crane slew
- Rider block to be moved either up or down
- Rider block to be moved either in or out
- Crane hook to be raised or lowered

(2) Controls should ensure that the hook and rider block never contact each other.

(3) Incorporate human factors in the RBTS/crane design to make controls "user friendly" so the crane operators will use the rider block to control pendulation.

(4) Redesign rider block arrangement to prevent sheaves at crane base from hitting deck-loaded containers on the containership and to prevent hitting the side of larger containerships with higher freeboard than the EXPORT LEADER. Figure 3-36 illustrates this problem and shows the rider block sheaves well within the envelope of the EXPORT LEADER. This figure clearly demonstrates that a ship with greater freeboard such as the U.S. Lines, AMERICAN NEW YORK (approximately 20 ft additional freeboard) would not be compatible with the T-ACS 1 as configured. Furthermore, additional clearance must also be provided to account for relative ship roll and T-ACS crane induced list. A 5-deg list of the T-ACS was observed on one accasion when 5 T-ACS cranes were boomed over the EXPORT LEADER all at the same time. Four of the cranes had containers suspended while the fifth was moving a hatch cover.

- Redesign the ship-to-ship mooring fender attachments to eliminate padeye failures and wire rope chafing. Chocks, bitts, and synthetic line should be considered in lieu of padeyes and wire rope. See Figure 3-1.

- Provide additional chocks, mooring bitts and a capstan along the mid-body to enable the use of more spring lines. This also gives more mooring flexibility with different type of containerships. Mooring lines should be much longer (now 300 ft) to enable use of doubled up spring lines. Detailed mooring procedures should be documented in appropriate manuals.

- Redesign and/or recertify the cranes to lift a SLWT plus a 10 percent margin and add a load indicator device for each crane.

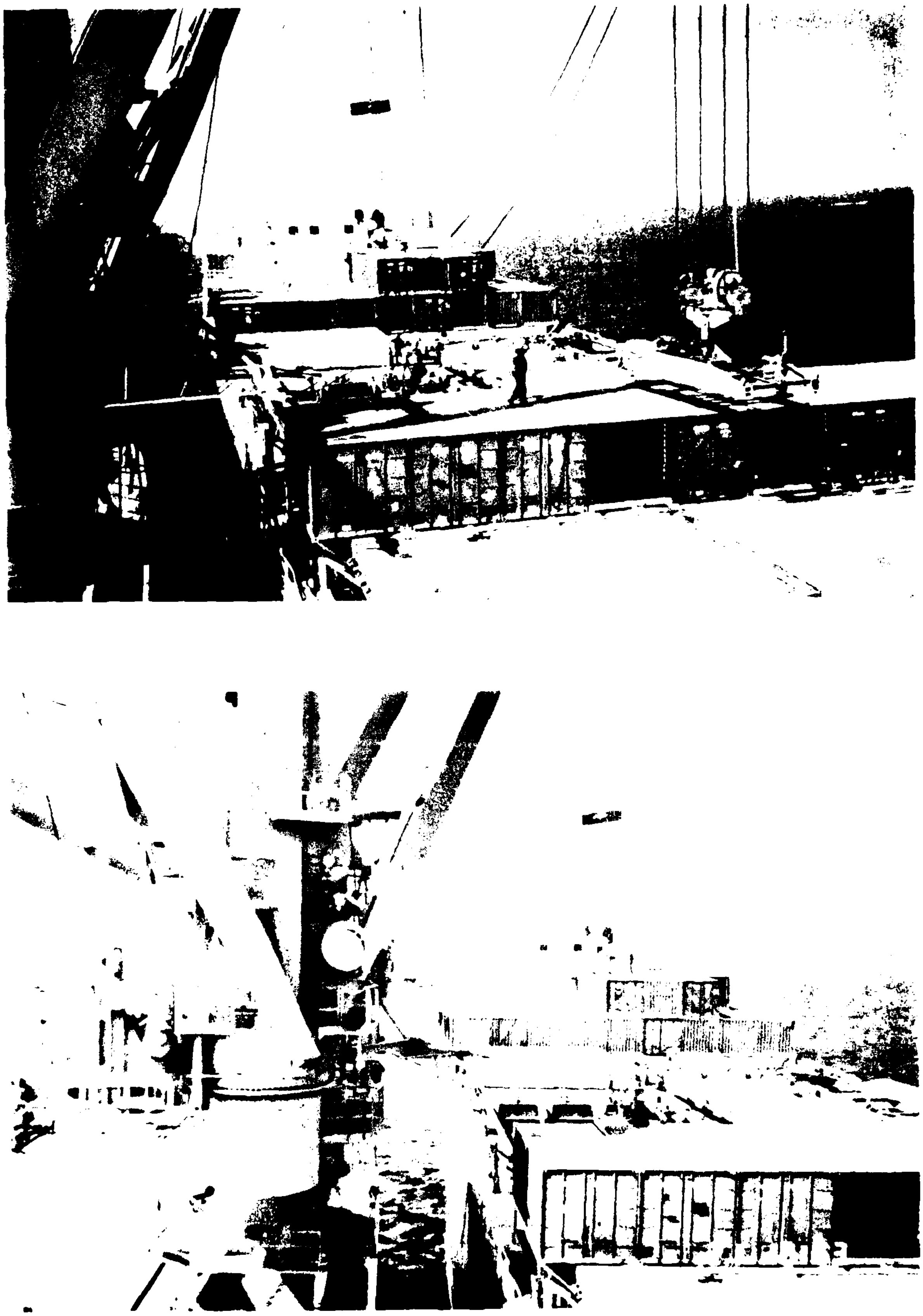


Figure 3-36 - Rider Block Sheaves over Containership

- Modify the RBTS to enable its use in both twin crane and tandem crane modes.
- Provide air conditioning for the crane operator compartments and adjacent electronics controller locations.
- Review the overhang of the starboard bridge wing of the T-ACS and the many variations in hull configuration of containerships to ensure that mooring can be completed without tug assistance.
- Investigate the addition of a stern anchoring system, such that the T-ACS can be positioned to:

  (1) Minimize rolling because of prevailing ground swells.

  (2) Provide a port-side lee for the loading of lighters.
- MSNAP berthing containers for stevedores should be considered to reduce the operational problems and hazards associated with transferring personnel, especially in rough seas.
- LCC on 04 level (port side) needs; remote antennas, chart table, signal lights, pelorus, radar, telephone, status board, lights, power outlets, and a high command chair.
- Guardrails to protect vulnerable deckhouse areas from damage resulting from swinging containers.
- Modify the H-fenders and/or provide a floating sausage fender system. See Figure 3-27.
- The T-ACS - Mission Operations Handbook[7] should be updated to reflect the lessons learned in JLOTS and described in this report.

3.2.1.2 Lighter Transit

<u>General</u>. The Causeway Ferries proved to be very effective lighters. The LCM-6's generally were not as capable as the CSP's in handling the causeway sections, but performed well overall. LCU's experienced great difficulties with sandbars at low tides and were unable to reach the LACH site a significant amount of the time.

<u>Time</u>. In accordance with the data collection plan, transit was measured from the time the lighter cleared the ship until it arrived on the beach. Consequently, the sometimes lengthy periods when the lighters were grounded on the sandbar at low tide and the time to winch the Causeway Ferries on the beach using dozers are included in transit. This is reflected in the times tabulated in Table 3-18.

TABLE 3-18 - NAVY/MARINE CORPS THROUGHPUT TEST
AVERAGE TRANSIT TIMES

Lighter	Includes All Recorded Data		Excludes Extreme Data Values	
	Average Transit Time	Sample Size	Average Transit Time	Sample Size
P1	60.3	11	43.9	9
P2	39.0	8	31.4	7
P3	39.0	10	39.0	10
F5	32.5	8	32.5	8
F6	62.3	9	45.4	7
Navy LCU	99.0	13	16.3	6

Observations by general observers consistently noted transit times in the vicinity of 20 min. These observers considered transit completed when the lighter came to rest, whether at the beach or grounded on the sandbar. For planning purposes, Table 7-10 in Section 7 proposes more realistic transit times, well within the tested lighter capabilities.

The first two columns of Table 3-18 include all recorded transit times during the Navy/Marine Corps phase of the Throughput Test. The following points provide some justification for eliminating extreme data values to produce the results tabulated in the last two columns:

- The major cause of extreme data values was the data system segmentation which did not account for delays when lighters grounded on sandbars during periods of low tide. The beach-side data collectors marked the end of transit as the time the "lighter arrives" (time the lighter was beached). The average transit times in the table include these sandbar delays. Transit time should have terminated when the lighter reached 100 yards offshore, and delays caused by sandbars would then be included in the approach and mooring time. The sandbar delay is especially obvious in the average "transit" time of the LCU of 99 minutes (including all recorded data) when considering that the LCU is capable of transiting

one mile in well under 20 minutes. LCU's were occasionally caught on sandbars for periods of an hour or more.

- When P3 and P1 were both seeking an open offload position at the beach, the P3 was given priority.

- Lighter transit times reflect the time spent offshore waiting for a beach slot to become available. This delay would be eliminated by opening up sufficient beach slots or by casting-off a lighter as soon as it was unloaded. Early in the test, the T-ACS would temporarily stop container operations while the ship swung on the tide. Empty lighters at the beach would be held and lighters in transit, especially the P1, would be held enroute awaiting an open beach slot.

- Causeway Ferry transit times included the time to hook up dozer towing cables and pull the ferry onto the beach.

- LCU's frequently diverted from their transit to perform periodic maintenance and several even returned to Little Creek to refuel. For example, six LCU transits were over 103 min with three over 230 min.

- Causeway Ferries would delay their departure from the beach while being refueled from a tank truck which entered the lighter from the beach.

- Shift changes would occasionally result in a delayed lighter departure and clearing of a beach slot for an inbound lighter.

The data collectors were unable to observe or interpret the above delays.

The average times in the last two columns are still out of order with regard to lighter capability. They were arrived at by excluding obvious extreme data values. The distribution of the remaining data did not provide a justifiable cutoff of any additional extreme values. Implicit in these remaining values are a variety of delays listed above which would not be expected to occur in a well planned operation. For example, there is no reason why a loaded P1, capable of at least 5 knots, cannot transit one mile in 20 to 25 min. This includes lighter manuevering and acceleration and deceleration at the start and completion of the transit leg.

Manpower. The personnel aboard the LCU's, causeway sections, and LCM-6's are listed below:

ιυ|

LCU	- 10
Causeway Ferry	
Causeway Crew	- 5
Two LCM-6's (3 ea)	- 6
P1	
Causeway Crew	- 5
CSP Crew	- 3
P2	
Causeway Crew	- 5
CSP Crew	- 3
P3	
Causeway Crew	- 5
CSP Crew	- 3

The causeway crew was provided to assist in directing and mooring the ferry and handling containers. The OIC of the causeway crew stood on the bow of the string of causeways and directed the LCM-6 or CSP operators by radio or hand signals.

Equipment. The following items were noted:

- The P1 had no difficulties handling a full load in spite of wind and current.
- The P2 and P3 experienced some difficulties controlling the loaded sections due to the large sail area and increased length subject to current forces. Control was maintained by anticipating the effects of the wind and current in advance.
- The LCM-6's experienced difficulty controlling the string of causeways approaching the beach. Because of their lack of power and maneuverability often required additional assistance when operating in close spaces.
- The LCU's could handle the wind and currents while enroute to the beach but once there, they often could not clear the sandbars at the beach (Discussed under Section 3.2.1.3.3.1).
- Navigational lighting aboard craft is critical to night time safety. Lighting on Causeway Ferries was generally poor because of their long low profile.

Procedures. Once clear of the T-ACS ship, lighters proceeded toward the beach. They then called 'beach control' which was run by Beachmaster Unit Two (BMU TWO). Beach control then directed the lighter to proceed to an open spot on the beach or to hold until a spot was clear. The procedure of using dozers to pull a Causeway Ferry onto the beach was usually unnecessary and should be done only when required to correct an incomplete beaching.

No specific area was designated for lighters to wait or 'queue' and they often drifted well away from the beach site, which required extra time for their approach when the beach was clear.

Environment. The current and wind at the test site gave the Causeway Ferries a good deal of trouble, especially when lining up to approach the beach, and when departing the beach. At these times, the lighters had to be virtually broadside to the current, and often to the wind also. The nearness of the ELCAS to the RTCH site proved to be dangerous since on several occasions collisions occurred between lighters and the ELCAS. The use of additional space between the beach systems and extra craft to control the lighters is recommended.

Conclusions.

- Causeway Ferries powered by the CSP were most effective lighters.
- LCU's were rapid but had a difficulty with sandbars. They would have been more effective at the ELCAS if it had been available.
- At low tide, sandbars caused very long delays of lighters, but the small draft of the Causeway Ferry sections enabled them to overcome the sandbars easier.
- Dozers should not be used to beach Causeway Ferries unless absolutely necessary.

3.2.1.3 Operations at the Beach

3.2.1.3.1 Elevated Causeway (ELCAS)

Due to the extended period required for ELCAS installation, it did not receive any containers during the Navy offload.

- One short Navy offload demonstration was run during the Army portion of the test. This consisted of backloading and then offloading one

3-section Causeway Ferry. The containers were loaded onto Army trucks at 2 per truck vice USMC trucks at 1 per truck. This one demonstration did not provide enough data to draw any meaningful conclusions of throughput rates.

- The ferry consisted of a powered causeway and 3 nonpowered sections. It was brought in very smoothly against the current by using a pusher boat on the bow to assist while the powered section pushed itself sideways with its waterjet nozzles (Figure 3-37). Once against the fenders, lines were attached to hold it for loading/offloading.

- When offloading containers from a Causeway Ferry, the ferry must be shifted along the fenders to allow the crane to reach all of the containers. The number of times it is shifted depends on its length. If the current is pushing the ferry away from the ELCAS, it is difficult to shift the ferry without the assistance of another craft to hold the bow against the current. With practice, it is possible to shift the sections while the crane is placing a container on the truck. This would eliminate the delays of the crane waiting for the shifting of the ferry.

- The traffic pattern used on the ELCAS by the Navy and Army was not established as recommended in the ELCAS Operations Manual. This traffic pattern is described and discussed in Section 5.2.1.4.1 (Army Container Throughput) of this report.

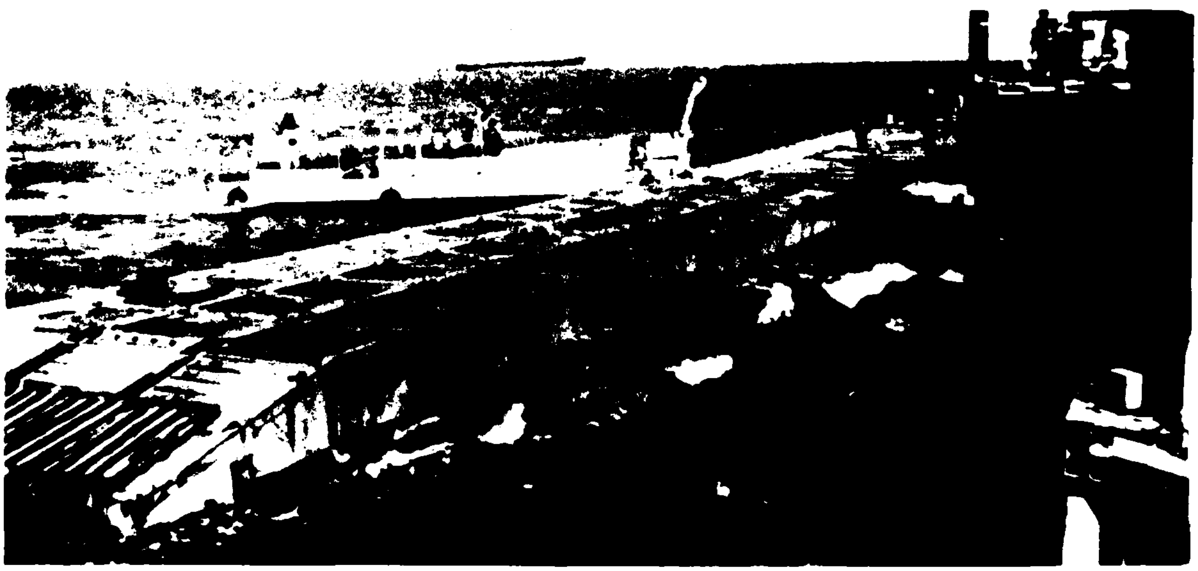


Figure 3-37 - Mooring Causeway Ferry to ELCAS

3.2.1.3.2 RTCH Site

Operations at the RTCH site included Causeway Ferry preparation offload, cargo unloading and truck loading, and Causeway Ferry cast-off and clear. As discussed in Section 3.2.1.2, lighter transit data covered the lighter movement until it was grounded at the RTCH site. Thus the movement through the surf zone across sandbars if they exist and to the beach water line, which is typically included in "Approach and Mooring"; is included in "Transit".

3.2.1.3.2.1 Lighter Preparation for Offload

There is a relatively undefined period between the time the lighter "arrives" and the time the RTCH enters the lighter (Figure 3-38) to commence container offloading. "Arrive" is not clearly defined in the data system and was recorded as the time the lighter was beached. Thus, the time the lighter spent grounded on the sandbar plus the time required for the dozers to hook up to each side of the bow section and winch the lighter

Figure 3-38 - RTCH Entering Lighter to Initiate Offload

further onto the beach was included in transit time. This Section covers the discussion and analysis of the period following transit to start of cargo offload.

<u>Time</u>. Table 3-19 summarizes the average preparation for offload time for the various Causeway Ferries operating at the RTCH site.

TABLE 3-19 - LIGHTER PREPARATION FOR OFFLOAD (RTCH SITE)

	Including All Recorded Data		Excluding Extreme Data Values	
Lighter	Average	Sample Size	Average	Sample Size
P1	8.4	11	2.7	9
P2	4.1	8	4.1	8
P3	8.6	10	5.5	8
F5	7.6	8	5.1	6
F6	8.0	9	2.3	7

The preparation for offload time includes the dozers shifting the lighter bows sideways if the intended beaching position was missed during the approach. It also includes the occasional "digging in" of the dozers to provide bow anchoring after the lighter was considered beached. Deploying the causeway beach ramp fingers and waiting for a RTCH to touch the ramp to start the offload segment were also included.

In Table 3-19, the two major columns, " Excluding Extreme Data Values" and "Including All Recorded Data", show the effect of a small number of extreme values on the average mooring and approach time. The values under the heading, "Excluding Extreme Data Values" are the average of all data except two extreme points which occurred in each case except for P2. The reasons for these extreme values are not evident in the data. They could

have been the result of a shift change, awaiting dozers or RTCH's, an administrative delay, misinterpretation by the data collector, or other test unique causes. The extreme values lie between 13 and 44 min whereas the remaining values are all 10 min or below. Since the extreme values represent only about 20% of the data points, the lower average is considered more typical.

Manpower. The preparation for cargo offload operation often involved use of two Navy dozer operators to shift the craft bow sideways and to anchor the bow. Once positioned, three or four lighter crew were required to deploy the ramp fingers. The lighter coxswain had to maintain control of the lighter stern position throughout the offload operation. All personnel appeared well trained in these operations and performed their tasks effectively.

Equipment. The primary support equipment required in the preparation for cargo offload mooring operation were the two Navy dozers used to position and to anchor the causeway bow for the offload operations.

Procedures. In the lighter preparation for offload context used throughout this discussion, the following procedures apply:

- If required, the dozer(s) positioned the bow of the lighter on the intended beaching spots while the lighter coxswain maintained stern position with side thrust.
- The dozers then dug into the sand at position angled off each side of the bow, put a strain on their winch lines connected to the lighter, and served as a bow anchor.
- The lighter crew deployed the ramp fingers by hand, one at a time. They appeared to struggle with the weight and possible hinge friction.
- After the fingers were deployed, RTCH's proceeded onto the ramp to commence offload operations. Some delay was caused by RTCH's not always being available/ready at the completion of finger deployment. These delays were usually caused by lack of personnel, not equipment.

Environment. The sea conditions during the five days of Navy offload operations were calm (see Table 2-7). Surf and wind did not pose any difficulties on causeways preparing to offload at the beach. However, the Fort Story beach has a significant tidal current which reaches about 1.5 knots even in calm weather conditions. Once the lighter bow was

grounded, the force of the current on causeways required side thrust to maintain the lighter's position perpendicular to the beach.

3.2.1.3.2.2 Lighter Offloading and Truck Loading

General. Unloading Causeway Ferries at the RTCH site developed into a rapid, efficient operation during the five days of Navy throughput. Marine Corps RTCH operators rapidly adapted to the equipment and the procedure after a relatively brief training period prior to the JLOTS Throughput Test.

Time. Table 3-20 summarizes the average container offload times of the five Causeway Ferry configurations which operated at the RTCH sites. These times were achieved using two RTCH's to offload each lighter.

TABLE 3-20 - AVERAGE CONTAINER OFFLOAD TIME AT RTCH SITE

Lighter	Average Offload Time Per Lighter (min)	Average Container Load	Sample Size	Average Offload Time Per Container (min)
P1	26.5	8.7	11	3.0
P2	44.6	16.4	8	2.7
P3	82.1	26.4	10	3.1
F5	66.8	25.6	8	2.6
F6	58.1	20.1	8	2.9

Table 3-20 illustrates a relatively constant container offload rate for the variety of Causeway Ferry configurations. The variation from 2.6 to 3.1 min/cont. is not considered significant and may be largely because of the small sample sizes in each case. However, one might expect a slight increase in time with the longer ferries to reflect the longer average transit distance for the RTCH.

Manpower. The container offloading operation in the RTCH area utilized personnel as listed Table 3-21.

TABLE 3-21 - MANPOWER USED AT EACH RTCH SITE

MARINE CORPS PERSONNEL MANNING AT EACH CAUSEWAY OFFLOAD SITE	
Function	**No. of Personnel**
RTCH Operator (2 RTCH's)	2
RTCH Spotter	2
Truck Driver	2
Truck Director	1
Container Lash/Tie-Down	4

Equipment. The primary support equipment required during offloading of the Causeway Ferries were two operating RTCH's for each of the causeway offload sites and a continuous availability of trucks at the two loading spots for each causeway. The RTCH's operated throughout the test with only a few minor maintenance casualties.

Procedures. A typical causeway offload operation would be performed as follows:

- Two RTCH's would alternate proceeding forward on the causeway, picking up a container, backing off the causeway, and loading the container onto an awaiting truck (Figure 3-18). Because of restricted forward visibility when carrying a container spotters normally walked (or ran) with the RTCH to guide it on the causeway and to position it for accurate loading of the truck.

- Containers would be secured to the truck trailer with chains, diagonally crossing at the front and rear-end of the container. Figure 3-39 shows securing crews at work immediately after placement of the container

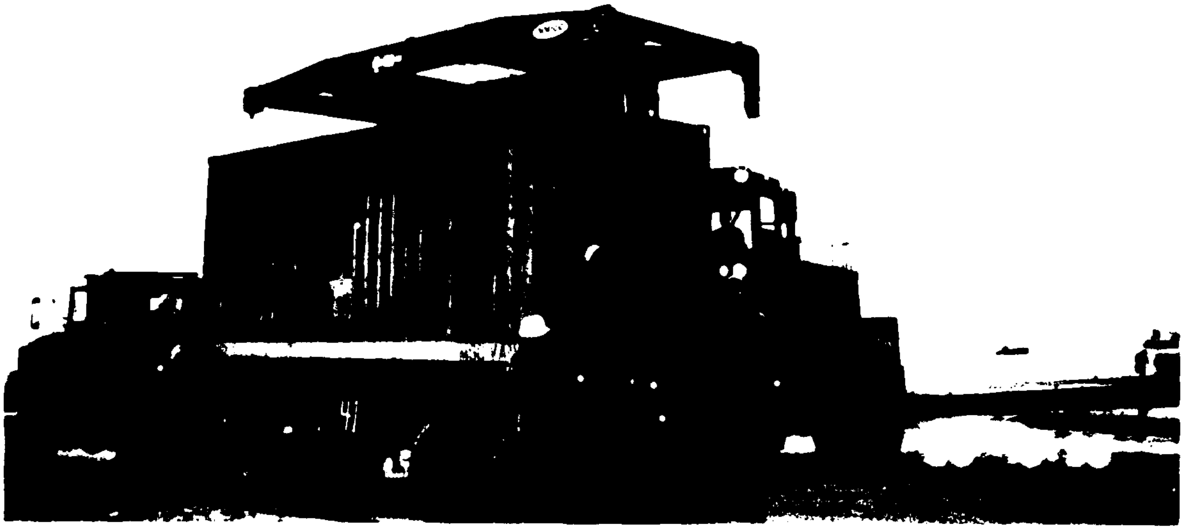


Figure 3-39 - Securing a Container to a USMC Truck

on the truck. When the container was secured, the truck would pull away from the loading mat and proceed to the Marshalling Yard.

- Upon the departure of each loaded truck, the truck director signaled the leading truck in the queue to proceed to the loading mat. The tiedown of the container and shifting of trucks usually occurred within the individual RTCH cycle time.

- There were occasions when trucks were not available. The RTCH would temporarily stack containers on the beach until a truck became available and truck loading continued normally. Upon completion of the causeway offload, the stacked containers would be loaded on the trucks. This task was easily completed within the time from casting off an empty causeway and mooring the next loaded one.

3.2.1.3.2.3 Cast-Off and Clear

General. Upon offloading the last container from a Causeway Ferry, preparations were made to clear the empty lighter from the beach to make room for the next loaded Causeway Ferry. Cast-off and clearing included: all time from completion of container offload to lighter clear of the beach. Within this time it included: disconnecting the two dozers used to anchor the causeway bow in position, stowing the ramp fingers using a forklift, pushing the ferry (if necessary) with dozers to assist the

causeway power unit(s) in the retracting process, and clearing the beach by several hundred feet before turning and returning to the ship.

This operation was not always smooth. Low tide caused the ferries to occasionally ground out on the sandbar off the beach, resulting in several lengthy clearing times. Strong tidal currents caused many near misses and several collisions with the ELCAS.

Time. Table 3-22 lists the average clearing times of Causeway Ferry lighters from the RTCH offloading areas:

TABLE 3-22 - LIGHTER CAST-OFF AND CLEAR FROM THE RTCH SITE

Lighters	Includes All Recorded Data		Excludes Extreme Data Values	
	Average Time	Sample Size	Average Time	Sample Size
P1	68.7	10	16.5	6
P2	141.8	8	42.8	5
P3	42.2	10	40.3	8
F5	102.6	8	43.4	6
F6	83.6	8	50.0	6

Comparison of the two sets of columns shows the effect of a small number of extreme values on the average lighter cast off and clearing time. The right hand columns reflect the exclusion of obvious extreme values, including seven values over 150 min with one value of 645 min. Causes for these extremes were not recorded, but it is assumed that they were test unique causes and not operational constraints. The averages tabulated in the right hand columns are still considered high, but there is no clear justification to support exclusion of further values.

The P1 had a dramatically shorter clearing time than the other ferries. One explanation is that dozers did not normally hook up to P1 to tow it further onto the beach and anchor it as in the case of longer ferries. It was apparently light enough and had sufficient power to beach and retract without assistance. In any event, the fact that dozers were not normally required is reflected in its shorter cast-off and clearing time.

Manpower. The maximum manpower used to clear the Causeway Ferries from the beach included two dozer operators, one forklift operator, lighter crew to disconnect dozer winch cable and operate the lighter. Lighter coxswains had difficulty maneuvering in cross-currents at the beach. This indicates a need for additional training and experience.

Equipment. The primary support equipment items utilized in the clearing operation were a forklift to lift the ramp fingers into the stow position and two dozers (max) to assist in the retracting.

Procedure. The typical retracting procedure was as follows:

- Disconnect dozer winch cable
- Stow ramp fingers
- Dozers push lighter off beach
- Lighter back clear of beach (several hundred feet) and turn toward ship.

The expected procedure following completion of lighter cargo unloading is to immediately initiate action to cast the lighter off, and clear the site for the next lighter arrival. During JLOTS II there were often more lighters available than were needed to service the T-ACS container operations. Rather than have lighters underway in a larger than necessary queue or pool waiting off the T-ACS, they were sometimes held at the beach after being unloaded. This procedure contributed to recorded cast-off and clear times longer than judged "necessary." However, the situation during the test made this procedure appropriate for the operational commander, and, therefore, must be viewed as operationally realistic. Therefore, cast-off and clear times are not further reduced to eliminate this influence.

Environment. Low tides and strong tidal currents were the primary environmental conditions which impeded the clearing of lighters from the beach.

Conclusion.

- Causeway Ferry cast-off and clear from the RTCH site required longer than expected times. Influencing factors observed are operating procedures, environmental conditions, and operator experience and training levels. These influences are considered operationally realistic.
- The RTCH site should be separated by 300 yd from adjacent lighter beach facilities to preclude lighter interferences during cast-off and clear operations.

3.2.1.3.3 LACH Site

General. The LACH site consisted of two LCU beaching locations identified by colored markers for guidance. In addition, two MOMAT truck-loading mats were angled off the Sand Grid road so the trucks could back their trailers toward the beach for easy straddle loading by the LACH's. The LACH site was located west of the RTCH and breakbulk sites as depicted in Figure 3-7.

3.2.1.3.3.1 Lighter Preparation for Offloading

Similar to the case for Causeway Ferries, LCU approaches to the LACH site were included in transit data.

Time. Lighter preparation for offloading includes only that time after the lighter is beached to the beginning of container offload. Lighter approach and mooring time, including time to cross a sandbar, is included in the recorded transit times. Average preparation for offload time for Navy LCU's was 5.2 min. This average is based on a sample size of 13. It includes all recorded data which ranged from 1 to 10 min.

Manpower. The manning during lighter preparation to offload consisted of the LCU crew.

Equipment. No special support equipment was required in this operation.

Procedure. Once the craft was beached, the ramp was lowered and a LACH was positioned to enter the craft.

Environment. There were no environmental conditions that were observed to have an effect on preparations to offload LCU's.

3.2.1.3.3.2 Lighter Unloading and Truck Loading

General. Two LACH's worked each LCU, alternating as in the case of the RTCH's.

Time. LACH offloading of LCU's at the beach was a relatively slow process in comparison with the RTCH operations. Times are given in Table 3-23.

TABLE 3-23 - LCU UNLOADING TIME AT LACH SITE

LACH OFFLOAD SITE				
Lighter	Avg Offload Time (min)	Avg Load (Containers)	Avg Time Per Container	Sample Size
Navy LCU	37.5	4.3	8.8	12

The relatively poor maneuverability of the LACH plus the tight operating tolerances in the LCU and straddling the truck trailers are the primary factors in the average time per container when compared with the Causeway Ferries (see Table 3-20).

Manpower. Table 3-24 lists typical manning required to perform the LACH offload. Skill and training levels appeared to be good.

TABLE 3-24 - MANNING AT EACH LACH OFFLOAD SITE

POSITION	CREW
1 - LCU	Standard Crew
2 - LACH	2-Dozer Operator 4-LACH Operators 2-LACH Director
2 - Trucks	2-Driver 2-Director 4-Tiedown Personnel
- Beach	1-Site Spotter

Equipment. The primary items of equipment utilized during offloading were the LACH and the single-container Marine Corps trucks equipped with container tiedown chains.

The LACH system is the only existing equipment capable of lifting containers off of 1600 Class LCU's beached in the surf zone. It was designed specifically to fit through the ramp opening of an LCM-8 and straddle 8-ft wide containers loaded longitudinally. Because of the tight dimensions even in the LCU, containers must be accurately spotted. The LACH can handle only 20-ft containers.

The LACH appeared to have no difficulty operating onto/off of the wet ramps. The tire footprint area more than accommodated the loaded LACH without sinking into wet or dry sand at Fort Story.

The Marine Corps performed minor LACH maintenance on the beach and more extensive maintenance in the rear area adjacent to the Marshalling Yards. LACH availability did not restrict container offloading.

Procedures. When the LCU ramp was dropped, the LACH was aligned with and pushed up the ramp by its dozer power unit. The LACH personnel, riding in its forward structure, and LCU personnel provided direction to the dozer operator to thread the machine through the tight spacing presented by the LCU and the container.

When the LACH was positioned over the container, its hydraulically powered spreader was attached to and lifted the container for offloading.

The LACH withdrew from the craft (Figure 3-40), was turned on the beach, pushed to a straddle position over the truck trailer (Figure 3-41), and the container was lowered. Meanwhile, the second LACH was proceeding onto the LCU to pick up the next container.

The LACH withdrew from the trailer after disconnecting the container and tiedown personnel secured the container to the bed. The truck then departed and an empty one took its place. Meanwhile, the second LACH was loading at the second truck spot and the first LACH started its next cycle.

The two LACH system worked well and it appeared that there was little slack time in operations both on the LCU and at the truck loading positions. Thus, the procedures used did not adversely affect lighter unloading and truck loading times.

3.2.1.3.3.3 Cast-Off and Clear

General. Cast-off of the LCU's began after the containers were offloaded. The craft retracted from their beached positions using propulsion power

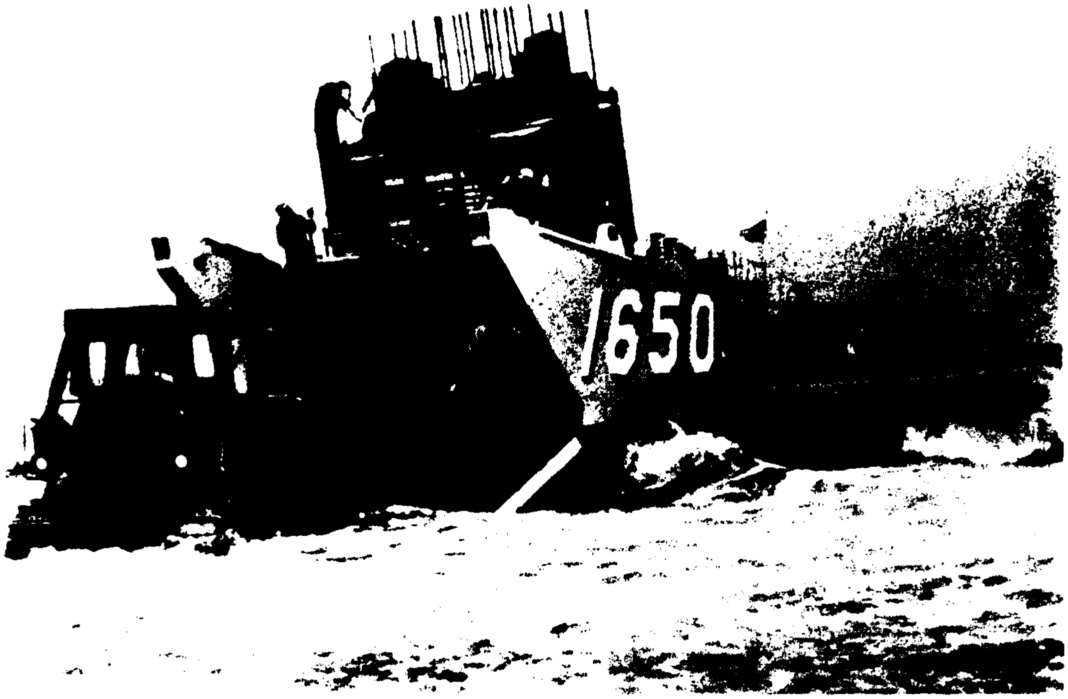


Figure 3-40 - LACH Removing a Container from an LCU

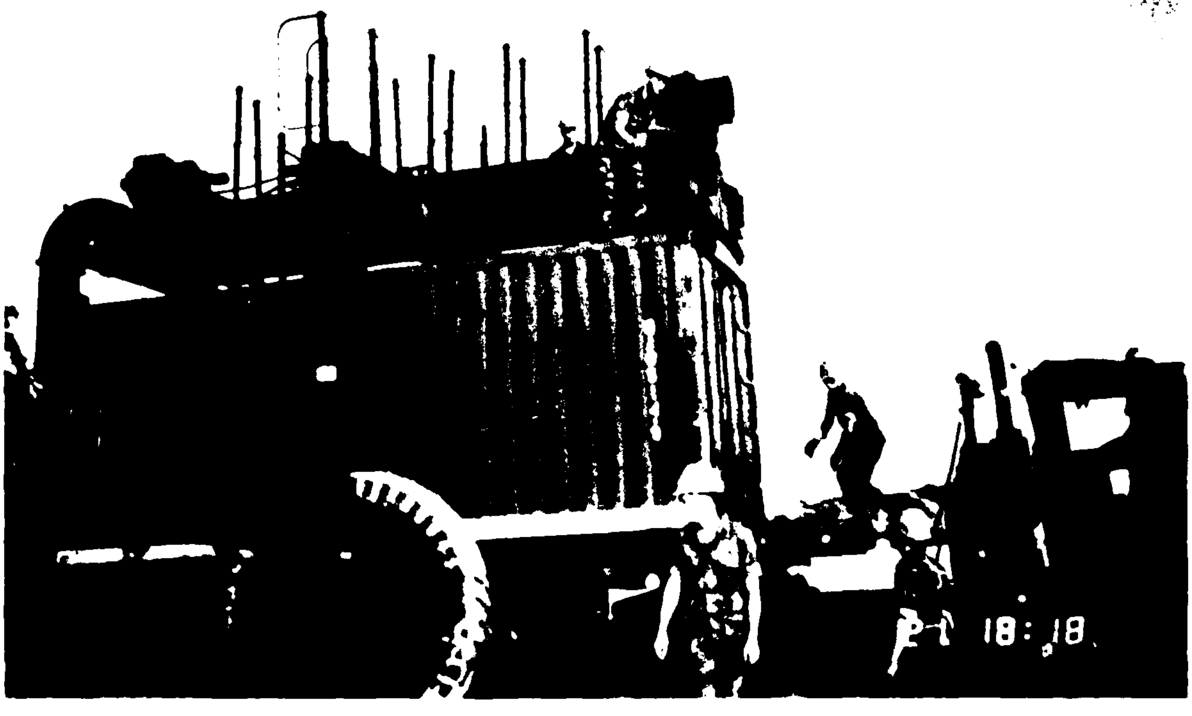


Figure 3-41 - LACH Loading Container on USMC Truck

assisted by winching on their stern anchor if it had been deployed during their approach and beaching.

Time. Cast-off and clearing time for Navy LCU's averaged 6.5 min as determined from a sample size of 10. The time was not affected by the raising of the ramp since this was usually done concurrent with craft retractions.

Manpower and Equipment. Clearing required no manning and equipment external to the LCU.

Procedure. If the stern anchor had been deployed during the craft's approach to the beach, it was available to assist the propulsion system in the cast-off and clearing operation. The craft backed clear of the beach and sandbar, turned around, and proceeded seaward. The procedures used did not adversely affect LCU cast-off and clear time.

Environment. The sandbar and bottom gradient at Fort Story had an adverse effect on LCU cast-off and clear from the LACH site. It is estimated that cast-off and clear time would have been 2 to 3 min instead of 6.5 min had there not been occasional difficulty backing over the sandbar at low tide.

3.2.1.3.4 Truck Transit

Marine Corps 5-ton tractors with M127 trailers were used throughout the Navy offload. These trailers carry only one 20-ft container. They are not equipped with corner fittings to secure and lock the containers to the trailers. Instead, hooks and chain lashings were used. This was accomplished by a crew of four persons. Two persons at each end climbed onto the trailer, one stood on a box placed adjacent the container to attach hooks to the top corners while the other attached the opposite end to the trailer. The chain was then tightened with a chain tensioner, the personnel jumped from the truck and it departed. Table 3-25 provides a breakdown of the times required to secure the container to the truck and transit to the Marshalling Yard, a distance of approximately 1.2 miles. Return transit time was not recorded since the trucks would return to a multi-vehicle queue or be refueled or maintained.

The time to secure the container to the trailer is longer at the LACH site than at the RTCH site. Container lashing begins immediately after it is placed on the trailer. AT the LACH site, the rear of the trailer is not accessible until the LACH is clear of the trailer, thus lashing that end is delayed.

3.2.1.3.4.1 Beach to Marshalling Yard

The transit times listed in Table 3-25 are for a transit distance to Marshalling Yard A of approximately 1.2 miles. A one-way road system (Figure 3-16) was used with traffic control personnel at crossroads to halt

TABLE 3-25 - USMC TRUCK TRANSIT TIMES (minutes)

		From RTCH	From LACH	Average
Day	Secure Cont.	2.2	5.6	3.3
	Transit	7.9	5.8	7.2
Night	Secure Cont.	3.1	6.9	3.9
	Transit	6.9	9.9	7.6
Day & Night	Secure Cont.	2.6	6.1	3.6
	Transit	7.4	7.3	7.4

other traffic. The trucks therefore did not have to stop from the time they left the beach until they reached the Marshalling Yard.

Just prior to leaving the beach the truck was stopped to turn in a sheet for the manual documentation system (Refer to Section 3.3.2.1). This stop required less than one minute.

Some variation is noted in the data for transit from the LACH site for day and night but the overall average agrees closely with transit from the RTCH site. The combined average of 7.4 min gives an approximate transit speed of 10 mph for the 1.2 mi route.

3.2.1.3.4.2 Truck Unloading in Marshalling Yard

As the truck entered the Marshalling Yard it stopped at a check-in point, turned in the forms for the manual container documentation system, and was directed to an offloading point. At this point, a RTCH or 30-ton hydraulic crane was waiting to remove the container. Four personnel removed the chain and tensioners from the container, the RTCH attached to it and lifted it off. If a 30-ton crane was used to remove the container, the personnel who removed the chain also handled taglines to guide the spreader bar onto the container.

The 30-ton crane placed the containers on the ground and they were transported to their stowage location by RTCH's, when they were not occupied offloading trucks themselves. Containers were stowed 2-high in a turret configuration (Figure 3-42) which allows a bottom container to be retrieved without having to place the top container in the aisle.

- The average time required to check in and offload was 3.3 min per truck using either a RTCH or 30-ton hydraulic crane.
- The RTCH had no difficulty operating on the sandy soil of the Marshalling Yards, or in maneuvering in 50-ft aisles between rows of containers.
- The 30-ton capacity hydraulic crane was effective as an expedient offloading device when the RTCH's were occupied, but they could not carry a container to its stowage site. Overall the greater flexibility of the RTCH makes it a better vehicle for operations in the Marshalling Yard.
- Marshalling Yard A was used as the main container Marshalling Yard with Marshalling Yard B acting as an overflow yard. Yard A contained

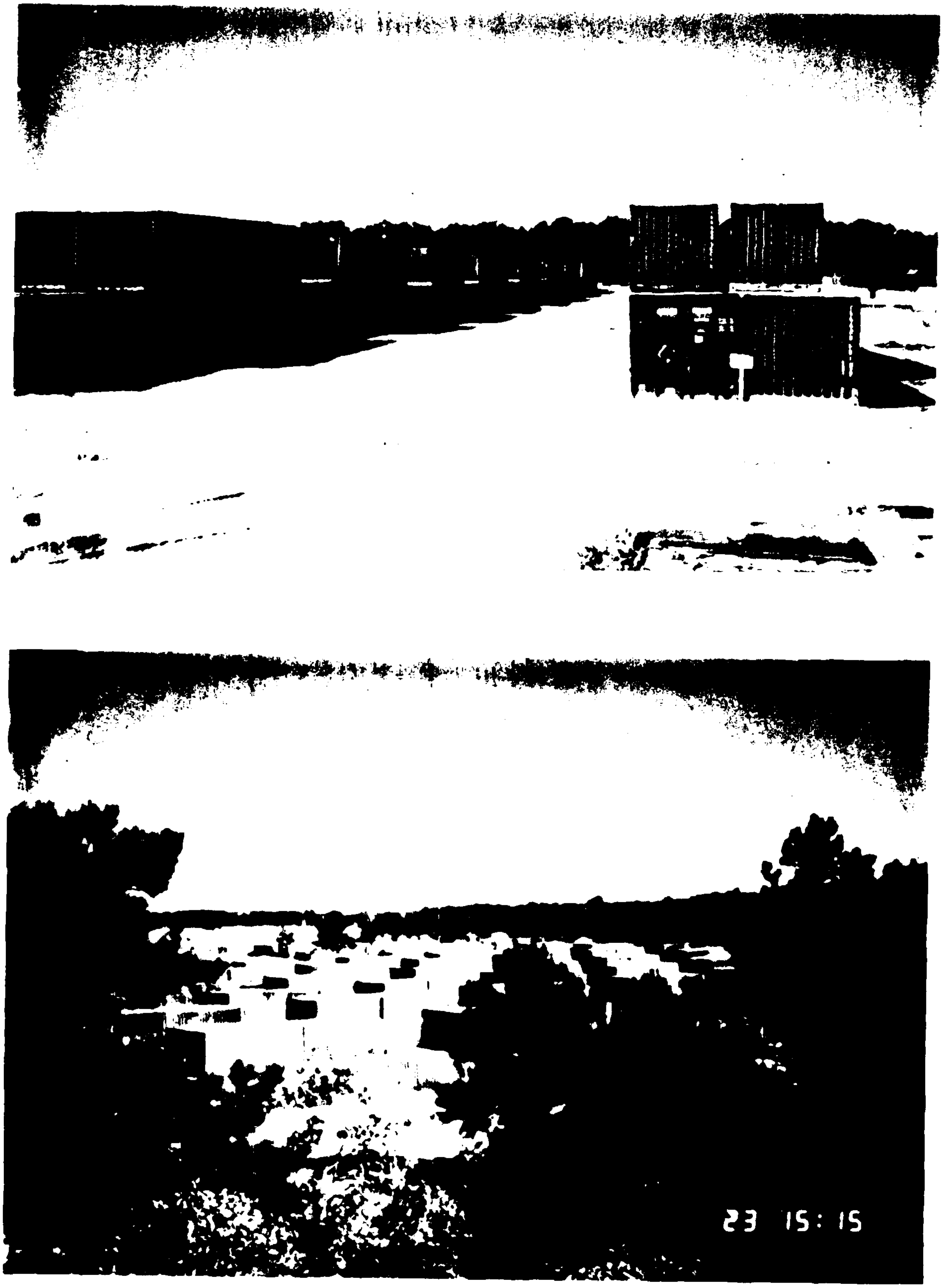


Figure 3-42 - Container Stowage in Marshalling Yard

856 containers (Figure 3-42) and Yard B, 48 containers when the Navy offload was complete.

3.2.1.4 Container Backload Operations

3.2.1.4.1 Container Backload Operations Offshore

The backload operations were intended to be an administrative retrograde to fill the containership in order to start the offload again. It should be noted that on 26 September, shortly after the backload started, a gale-force storm front arrived at the test location. Waves increased very quickly from about 1 ft at 1500 to over 6 ft by 1800. The seas diminished somewhat by the morning of 27 September but remained in the 3-1/2-ft to 5-ft range (Sea State 3) from 27 through the 30 September. The heavy seas coupled with the increased difficulty of backload operations compared to offloading, resulted in only 73 containers being backloaded in the four days of 27 through 30 September. General observations were collected throughout the backload period and these observations have been reviewed and evaluated. The following comments with conclusions and recommendations resulted:

- The automatic spreader could not be attached to containers in LCU's. It was impossible for the crew to precisely align this heavy spreader even in calm seas over the container. After repeated attempts, they gave up and replaced the spreader with slings. The automatic spreader is unsatisfactory for backload.

- Two 20-ft containers were placed end-to-end within the 40-ft cells of the EXPORT LEADER. This made backloading difficult since only the two end cell guides could be used to align a container as it was lowered into the cell. Also, several containers were not balanced and became wedged between adjacent containers and cell guides.

- Backload operations require special training because of the hazards involved. On several occasions the top of a container would get caught under a walkway at a corner cell gusset plate in the containership hold. This is a very dangerous condition because if the ships roll apart, a tight line condition will result with the possibility of extensive crane damage (i.e., parting the hoist line) and dropping the load. Operating manuals should describe safe backload procedures.

3.2.1.4.2 Beach and Onshore Container Backload Operations

Backload operations on the beach and onshore were basically the reverse of the offload operations and were performed administratively. As discussed in Section 3.2.1.4.1, a storm disrupted backload operations and limited the number of containers backloaded to 73 in the four days remaining in the Navy/Marine Corps portion of JLOTS II.

The following comments with conclusions and recommendations resulted from review of the general observations:

ELCAS

- This was the first chance to use the ELCAS, and backloading was performed by Causeway Ferries and LCU's.

- The period was used to train crane operators who were not experienced on the ELCAS.

- A "one at a time" truck operation was established. The trucks were offloaded, driven to the turntable, turned around, and driven off the pierhead before the next loaded truck was driven to the crane. This is an inefficient use of the ELCAS which was designed for the trucks to pass on the pierhead.

- All craft had difficulty mooring at the ELCAS when the current was pushing them away. An extra warping tug was used to push the bow of Causeway Ferries into place.

- The pins of the shackles securing the foam filled fenders to the ELCAS were not seized properly and worked loose in the heavy weather (Figure 3-43). Several foam fenders broke loose. They were subsequently secured to the fender section with line which periodically broke or wore through thus requiring constant maintenance. When properly secured, the fenders performed adequately.

- The ELCAS fender piling, which were supposed to assist in supporting the pierhead, worked loose. The bolts holding the pins at the pierhead, on several of the piling were loosened, and several pins were lost or removed (Figure 3-44). This is a result of lack of maintenance to the pinning system.

Figure 3-43 - ELCAS Fender, Storm Damage

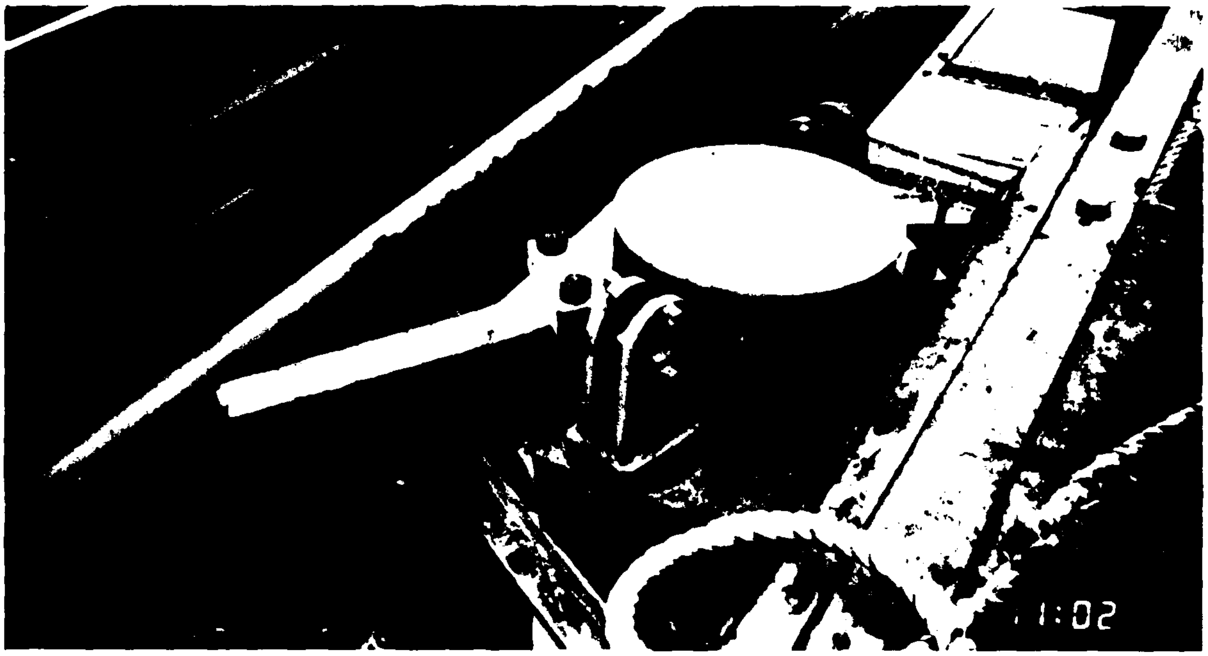


Figure 3-44 - Loose Pin on ELCAS Fender Piling

- Winds in the area of 20+ knots caused crane operations to cease. This condition usually occurred about the same time that the wave height increased to the point where lighters had difficulty approaching and mooring at the ELCAS.

- The ELCAS pierhead was located just beyond the breakers, according to Navy doctrine. However, it was in the area where waves build prior to breaking. This caused the LCU's to surge against their mooring lines (not as much effect on the longer causeway lighters) which makes mooring more difficult and puts personnel working in the area in danger of being hit if a line breaks. It is recommended that one or two additional causeway sections be used in the roadway to move the pierhead to deeper water beyond the building area of the larger (Sea State 2-3) waves.

RTCH

- The RTCH experienced no difficulties backloading causeway lighters.
- The dozers used to stabilize the causeways continually made the mistake of pulling the end up onto the beach before it was loaded. Containers were then placed on the entire length including the bow (another mistake) which made it very difficult to push off the beach.

3.2.2 Breakbulk Operations

3.2.2.1 Operations of Breakbulk Ship

The breakbulk ship used during the throughput test was the SS CAPE ANN and was obtained from the Ready Reserve Force. The SS CAPE ANN was loaded with 2100 short tons of palletized training cargo by Army units at a James River anchorage. On 20 September 1984, offload operations commenced under the operational direction and control of Commander, Amphibious Squadron Four. Stevedore personnel were provided by the Naval Cargo Handling and Port Group (augmented by USN Reserves). During the USN/USMC test period, 323 STons of palletized cargo were transferred ashore during an average 10-hr work shift. The Navy offloaded the entire 2100 STons which consisted of 1,951 individual pallets in 3-1/4 days.

The primary purpose in conducting breakbulk ship operations during the Throughput Test was to evaluate the effects of simultaneous container and breakbulk operations. Overall, the Navy/USMC managed the flow of container and breakbulk cargo with few problems, and there were no interference or lighterage control difficulties. It should be noted that the breakbulk cargo used in JLOTS II did not include large outsized items that will represent a large portion of the cargo in an actual resupply operations.

3.2.2.1.1 Lighter Operations

LCM 8's and LCU's were the only lighter types used and they moored at four berths, two on each side of the SS CAPE ANN, throughout most of the test. On occasion, operations on the windward side would be halted because of the LCM 8 motions.

Initially, the fendering and mooring of lighters alongside the SS CAPE ANN was delayed because neither ship nor lighters were equipped with adequate fenders to conduct offload operations. Fendering was initially provided by the Assault Craft Unit (ACU) TWO with subsequent support coming from CAPE ANN through her assigned shipyard support. This problem should have been anticipated since breakbulk ships do not normally carry fenders for instream discharge.

Lighter control procedures during breakbulk operations were similar to those previously described in the T-ACS section of this report. However, Lighter Control Center (LCC) manning and equipment was minimized since a dedicated LCC space can not be assured aboard each breakbulk ship.

3.2.2.1.2 Cargo Loading onto Lighters

On the first day of the tests, 20 September, the ship's generators failed, which caused a 6-hr delay until shipyard electricians could make the necessary repairs. Also some of the rigs required modifications and repairs before they could be used. The overall poor condition of the ship caused numerous delays, and considerable improvisation was required to get the job done. Also, cargo loadout and preparation of the ship had not included planning for an adequate supply of stevedoring tools and equipment to be aboard. Had this been done, it would have been possible to augment the ship's equipment locker with such items as spare line, slings, cargo nets, forklift repair parts, tools, fenders, and banding equipment.

Standard yard and stay rigs were used for cargo transfer. Craft positioning was adjusted to spot cargo in the desired location. The LCM-8 worked well as long as the sea state was low (1 or 2). LCU's are more effective for breakbulk transfer since they are more stable platforms, have much more deck space available and utilize a forklift to reposition cargo. Figure 3-45 shows LCM-8's, and LCU's being loaded.

3.2.2.2 Lighter Transit

The basic purpose of the breakbulk operation was to evaluate the effect of these operations on container throughput. Lighter traffic was one area thought to possibly cause interference, both in traffic control and in physical interference. There were a total of 68 LCU and LCM-8 lighter trips from the breakbulk ship to the beach during the 6-day Navy operation (compared to 60-container lighter trips). Table 3-26 gives a breakdown of lighter trips by shift.

- The breakbulk ship was to the East of the container and TACS ships and the breakbulk beach was to the West of the RTCH site. The landing craft therefore crossed paths (Figure 3-46) using standard rules of the road.

- No interference with container operations was noted.

Figure 3-45 - Breakbulk Offshore Operations

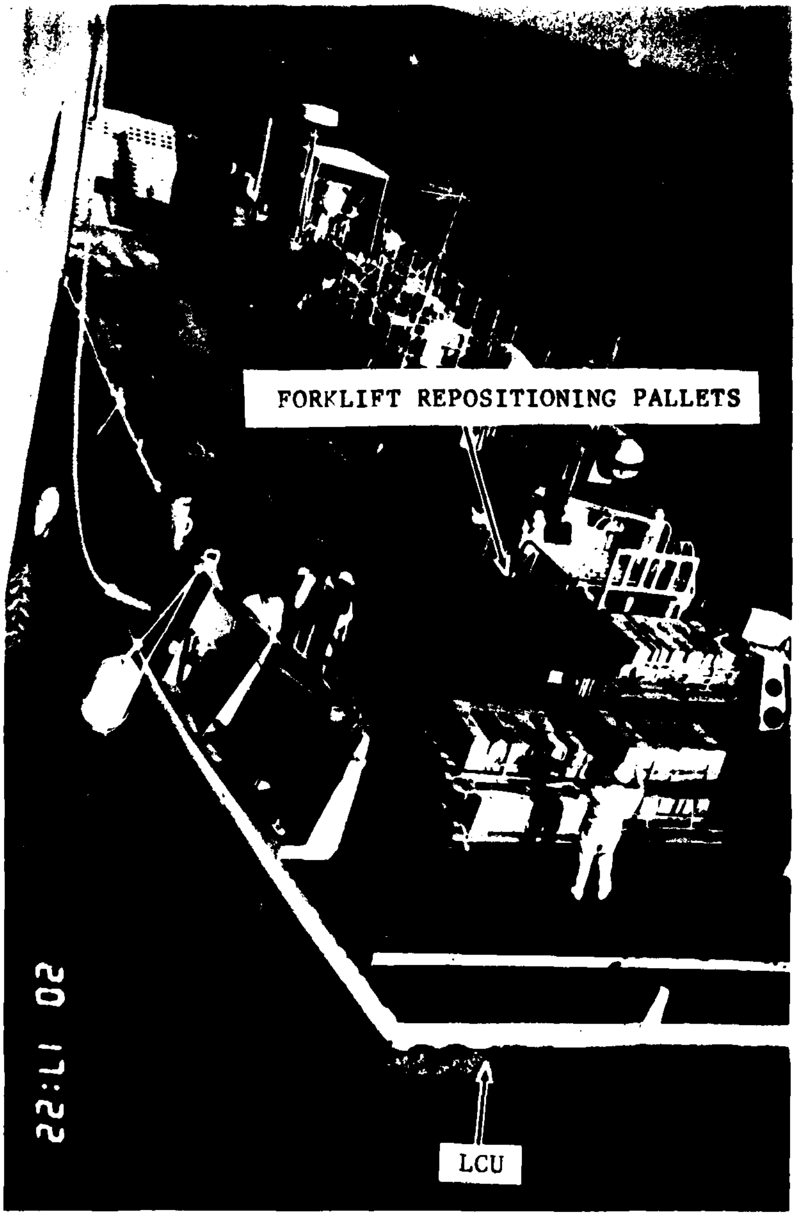


Figure 3-45 (cont) - Breakbulk Offshore Operations

TABLE 3-26 - NAVY BREAKBULK AND CONTAINER LIGHTER TRIPS

Shift		Breakbulk Lighters			Container Lighters		
		LCU	LCM 8	TOTAL	Causeways	LCU	TOTAL
20 Sep	Day		6	6	4	2	6
	Night	3	8	11	5	2	7
21 Sep	Day	2	7	9	6	3	9
	Night	4	8	12	4	1	5
22 Sep	Day	2	8	10	6	-	6
	Night	4	7	11	5	-	5
23 Sep	Day	1	8	9	4	5	9
	Night	-	-	-	6	-	6
24 Sep	Day	-	-	-	6	1	7
	Night	-	-	-	-	-	-

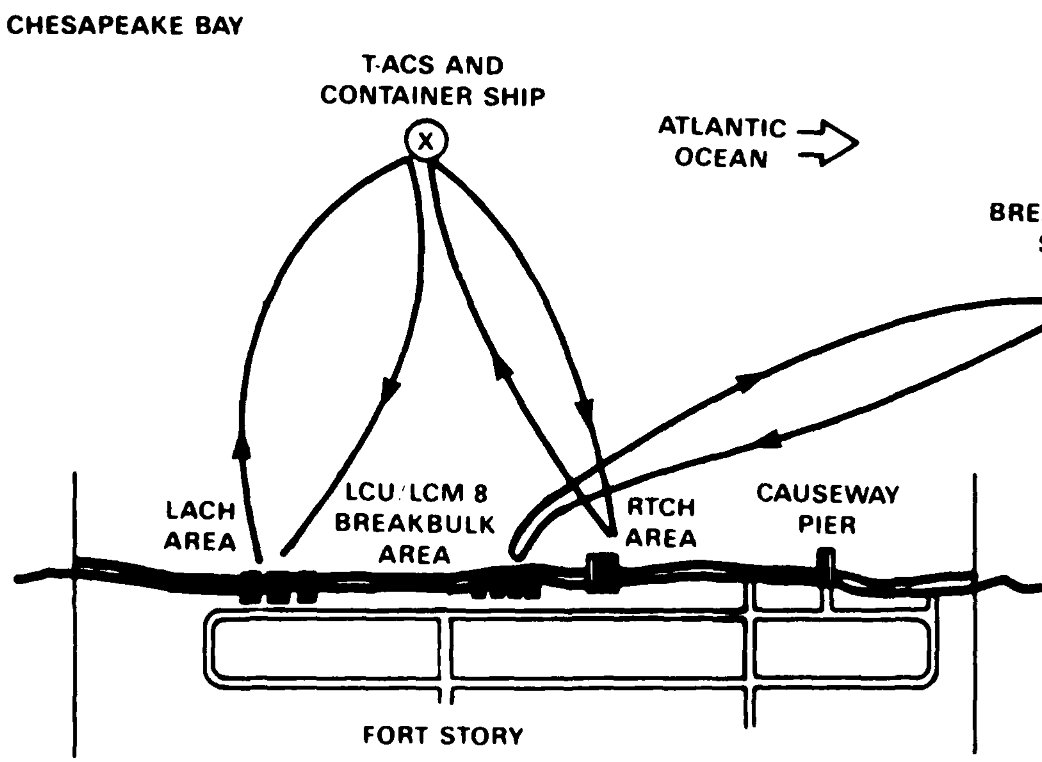


Figure 3-46 - Traffic Pattern for Navy Lighters

3.2.2.3 Beach Onshore Operations

The breakbulk offload activity was incorporated into the Throughput Test to observe possible interference/interaction with the concurrent container offloading operation. Data recording was minimal.

3.2.2.3.1 Breakbulk Beach Site

Data collection was limited to lighter offloading and truck loading at the beach. No data are available on lighter transit, approach and moor, and cast-off and clear.

In general, breakbulk operations at the beach did not interfere with container operations, either in lighter offloading or in truck transit except for isolated incidents where a container truck had to stop momentarily while a breakbulk truck parked.

Time. Breakbulk lighter offloading times are summarized in Table 3-27.

TABLE 3-27 - BREAKBULK OFFLOAD AT BEACH

	Avg Offload Time (min)	Avg No. Of Pallets	Avg Time Per Pallet (min)
LCU	62	62	1.0
LCM-8	22	18	1.2

The average time per pallet is essentially the same for both lighter configurations. The slightly longer time for the LCM-8 might be attributed to tighter operating space for the fork lifts.

Manpower. The manning of a breakbulk offload site is listed in Table 3-28.

Equipment. The primary support equipment utilized during offloading of breakbulk pallets at the beach were the 4000 lb and 6000 lb forklifts (4 per site max). The 6000 lb forklift appeared more suitable for this operation because its size and weight made it more stable and it appeared to transit the lighter ramp with less slipping. Also, the larger forklift could operate on a wet ramp in deeper water than the smaller one.

TABLE 3-28 - MANPOWER AT BREAKBULK SITE

Function	Number of Personnel
Craft Crew	Standard
Beach Signalman	1
Forklift operators	2-4
Forklift Spotters	2
Truck Director	1
Cargo Tiedown, per Truck	4-6

Procedures. The LCM-8's and 1600 Class LCU's beached themselves as high onto the beach as possible to provide the forklifts easy access to their bow ramps. When the tide was low, the LCU's were frequently grounded on the sandbar beyond reach of forklifts. However, under all but extreme low tide conditions, the LCM-8's were able to achieve a beach position accessible to the forklifts. They would occasionally have to make multiple attempts, but were ultimately successful in eroding a pathway across the sandbar to the beach.

Once a lighter was beached and its ramp deployed, offload operations proceeded as follows:

- Two forklifts alternated entering the lighter and retrieving the pallets. A lighter crewman would direct the forklift in and out of the cargo deck. As time progressed, they attempted stacking several pallets. This proved to be unstable since the top pallet was not restrained and it would occasionally fall off as the forklift descended the ramp (Figure 3-47) or bounced over the ruts in the beach.

1 10

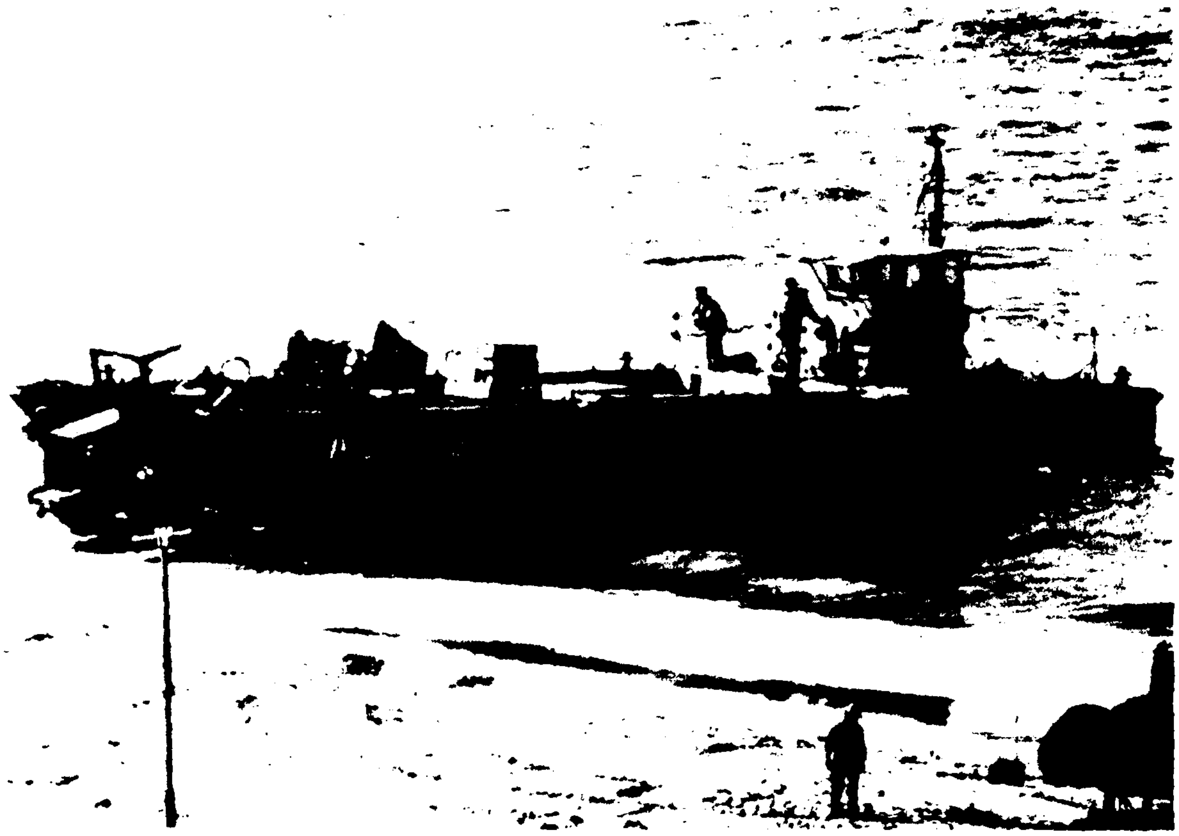


Figure 3-47 - Unloading Breakbulk Cargo from LCM-8

- The pallets were stacked onto trucks in the truck loading zone at the edge of the Sand Grid roadway.

- When a truck load was completed, the pallets were secured in place by nylon straps. Stevedores would assist in spotting and securing the pallets on the trucks.

- Damaged/dropped pallets were piled in a central location back from the Sand Grid roadway and a team of stevedores would reassemble and reband them.

Environment. The major environmental problem was that of low tide. As mentioned previously, LCU's could not drive across the sandbar at low tide and would occasionally be hung up for an hour or more waiting for the tide to rise.

Conclusions.

- The 6000 lb forklift appeared more suitable for offloading breakbulk because of its superior stability over the 4000 lb forklift.

- Two forklift trucks should be used to offload each lighter for maximum productivity.

3.2.2.3.2 Truck Transit

Two types of trucks were used to transfer breakbulk cargo to the Marshalling Yards. These were the M923 five-ton cargo truck and the 5-ton tractor with M127 flatbed trailer which were also used to transport containers.

- The pallets of breakbulk cargo were placed on the trucks as they were removed from the lighters.

- The pallets were placed in the 5-ton cargo trucks from the rear (Figure 3-48) and the M127 trailers were loaded from the side (Figure 3-49).

- The trucks were parked just off the road, but close enough so that forklifts used the road when loading one side of the truck. This caused occasional interruptions in the flow of the trucks to/from the LACH/RTCH container sites.

3.2.2.3.2.1 Beach to Marshalling Yard

The route from the breakbulk area on the beach to the breakbulk Marshalling Yard was in part the same as that for trucks carrying containers to Marshalling Yards A and B (Refer to Figure 3-19). Separate Marshalling Yards and one-way traffic ensured that interference was minimal. No delay of trucks due to heavy traffic was reported.

3.2.2.3.2.2 Truck Unloading in Marshalling Yard

The trucks were directed to an unloading station once inside the yard. The straps were released and 4000 lb or 6000 lb forklifts unloaded the truck and stacked the pallets in rows in the yard.

The following observations, comments, and recommendations were noted:

- Pallets that arrived at the yard in poor condition were sent back to the beach for repair. A separate area is recommended at both the beach and the Marshalling Yard to repair pallet loads. This would eliminate extra trips to and from the beach.

- There were up to five of each size forklifts available to offload trucks. This was adequate to prevent major delays in breakbulk throughput.

Figure 3-48 - Loading 5-Ton Cargo Truck

Figure 3-49 - Loading M127 Trailer

• A total of 25 people were involved in the operation of the breakbulk Marshalling Yard.

• Dust created visibility problems and could impact on personnel/equipment performance. An occasional spraying of water is recommended to reduce dust in the offloading area.

3.2.2.3.2.3 Marshalling Yard to Beach

The trucks continued around the one-way road circuit (Figure 3-19) and returned to a queuing area on the beach (Figure 3-50). The breakbulk trucks were queued in a separate row from the container trucks to allow for calling trucks to each area independently. Traffic control personnel were stationed at the LACH, RTCH, breakbulk and truck queue sites to call and direct trucks to open loading positions.

Figure 3-50 - USMC Trucks in Beach Queuing Area

3.2.3 Bulk Fuel Throughput

The Navy and USMC bulk fuel systems operated during JLOTS II testing were the Amphibious Assault Fuel Supply Facility (AAFSF) and the Amphibious Assault Fuel System (AAFS).

3.2.3.1 AAFSF

General. The AAFSF transferred 169,000 gal of water to the beach during its two days of operations.

Time. Table 3-29 presents the times required to perform the various events which occurred during the AAFSF operation. The major delay times are included and discussed below:

Manpower,and Equipment. Table 3-30 lists the major equipment items and the personnel associated with each.

Procedures. Empty bladders were towed to the tanker one-at-a-time, moored, and filled. They were then towed to the floating pump, moored, and pumped empty. Once operations have begun this is supposed to be a continuous cycle. However, the system was originally planned for daylight operations only so none of the equipment has lighting for night operations. This greatly restricts the throughput capability of the system, since towing and mooring operations must be completed before dark. Two of the 3 bladders were only partially filled at the tanker in order to have time to tow and moor them at the pump before nightfall. One of these could not be moored due to the current and darkness, and was finally towed to Little Creek and not pumped out at the test site.

The following comments, conclusions, and recommendations were noted:

- Personnel were not totally familiar with the operation and had little experience. If the operating time was extended their performance of the tests would have improved considerably.

- Unfamiliarity with unmooring from the tanker resulted in a SLWT damaging a bladder.

- Damage to the bladders during the operation consisted of tearing of flotation panel covers and a stabilizer skirt. Neither incident seriously affected the performance of the bladders, however, the flotation panel covers had torn repeatedly during the developmental tests of the AAFSF. Development of a more reliable flotation system is needed.

TABLE 3-29 - AAFSF THROUGHPUT TIMES

Date	Time	Event
10/6/84	1005-1048	Bladder #1 moored and connected to tanker.
	1054-1230	Tanker pumped approximately 120,170 gal into Bladder #1.
	1302-1315	Bladder #1 disconnected from tanker.
	1315-1538	Delay due to SLWT with Bladder #2 fouled in Army floating hoseline.
	1538-1610	Bladder #2 moored and connected to tanker.
	1614-1703	Tanker pumped approximately 91,000 gal into Bladder #2.
	1703-1725	Bladder #2 disconnected from tanker.
	-1948	Bladder #2 towed to Little Creek due to darkness.
	1453-1649	Bladder #1 moored and connected to pump station.
10/6-7/84	1649-1246	Delay due to kink in floating hoseline.
	1246-1732	Approximately 110,700 gal pumped ashore from Bladder #1.
	1400-1418	Bladder #3 moored and connected to tanker.
	1418-1545	Tanker pumped approximately 63,000 gal into Bladder #3.
	1545-1610	Bladder #3 disconnected from tanker.
	1700-1900	Bladder #3 moored and connected to pump station.
	1900-2330	Delay due to current pinching off hoseline.
10/8/84	0011-0303	Approximately 58,000 gal pumped ashore from Bladder #3.

TABLE 3-30 AAFSF OPERATIONS PERSONNEL AND EQUIPMENT

Item	Quantity	Personnel
SLWT	2	6
Towable Bladder	3	
60KW Generator	1	
AAFSF Mooring & Pump Buoy	1	
Floating Hoseline	1	
Beach Station and Power Cable	1	
BMU Detachment with LARC	1	8
Tanker	1	6

- The hoseline was not given a leak test following installation, and locating and removing a kink in the hose delayed pumping from 1700 on 6 October until 1246 on 7 October.
- Darkness prevented operations using the tugs since no lighting was available. No trouble shooting or repair actions can take place at night.
- Communication equipment was generally poor and contributed several minor delays during operations and troubleshooting effort.

Environment. One of the major factors affecting the throughput of the AAFSF was the strong crosscurrent present at Fort Story.

- In one case a SLWT towing an empty bladder was pulled into the adjacent Army floating hoseline by the current. This was due either to a steering failure or operator error since the craft has plenty of power to tow an empty bladder. The SLWT snagged on an anchor line and required about 2 hr to get loose.

The mooring system had never been operated in a crosscurrent this strong. This resulted in some major problems which might have been solved if the operating period had been longer.

- Mooring the full bladders to the AAFSF mooring buoys was very difficult and required the assistance of a second craft.

Once moored the crosscurrent pulled the bladders sideways which pulled the buoys under. This force pinched the bladder preventing flow to the pump. By waiting for slack current, the bladder could be emptied.

A solution must be developed to enable operations in currents of at least 1.5 knots. Possible solutions include reorienting the mooring of the bladders with the current or attaching a SLWT to the stern of the bladder and pulling it over to align with the current.

Some difficulty occurred due to the Sea State conditions. Increased training and operator experience should reduce the difficulties encountered. Operations in Sea State 3 would be very hazardous, however, due to the low freeboard of the SLWT and the need for working over-the-side.

Summary. The times and throughput quantities for the towable fuel bladders are shown in Table 3-29. A total of about 275,000 gal was pumped from the tanker into three towable fuel bladders. Two of these were pumped to the beach for a total of 169,000 gal, far short of the goal 440,000 gal per day.

The problems which caused major delays in the 2-day operation were: a kink in the hose which delayed pumping to the beach, high current which in effect pinched off the end of the bladder from the pump, and darkness which prevented 2 of 3 bladders from being filled completely at the ship and hindered troubleshooting of problems at the beach.

Equipment and procedures should be improved to achieve a capability to operate safely in Sea State 3 conditions. Development of lighting is strongly recommended to permit night operations.

3.2.3.2 AAFS

The USMC AAFS system originally installed was not used. It was recovered prior to operations due to high tides covering the area. The seven 20,000 gal bladders were replaced with three 50,000 gal bladders borrowed from the U.S. Army.

The installation and operation of the Army bladders is basically the same as that of the USMC bladders, so no difficulties were experienced. The bladder location was moved inshore between two sand dunes.

One towable bladder of 110,000 gal was pumped from the AAFSF to the USMC's borrowed bladders and then into the Army's stowage system. Scheduling constraints forced the USMC to retrieve the three borrowed bladders prior to pumping the second AAFSF towable bladder. The second bladder was pumped directly into the Army's stowage system.

No problems were experienced in pumping to or from the borrowed 50,000 gal bags. Installation of the system well back from the beach is recommended to prevent damage or relocation due to high tides.

3.3 CONTROL/DOCUMENTATION

This Section contains the analysis and discussions of Command Control and Cargo Documentation during the Navy/USMC portion of the test.

3.3.1 Command/Control

The means of directing and coordinating the efforts of units involved in an over the shore operations are not the subject of definitive guidance in service doctrine. The unknowns of location, task force composition, host nation support, and nature of the military campaign being supported contribute to this lack of a fixed organization structure. Accordingly, prior to JLOTS II, considerable discussion and effort was expended in development of the command relationships that finally evolved. The test scenario assumed that the Amphibious Assault had been completed, consequently the command/control structure for the Throughput Phase had to be developed by both USN and USMC elements. Conclusions are as follows:

- The concept of using an Amphibious Squadron and a Primary Control Ship to exercise command and control during the Naval phase of JLOTS II was effective. This arrangement would have been adequate to direct the discharge of 3-4 ships, simultaneously.

- The criticality of staffing a Lighter Control Center (LCC) on the T-ACS was underestimated by both Navy and Army commanders. Personnel controlling the approach, mooring, loading, and clearing of lighters at the T-ACS must be experienced, decisive, and possess the authority to fully manage lighter resources. Personnel manning the LCC must work closely with the deck officers aboard the T-ACS. The integration of cargo handling efforts by stevedores and crane operators with lighter operations has

direct impact on cargo movement. See Section 3.3.1.2 for a more detailed discussion.

- Although standard tactical radio and telephone equipment was satisfactory to provide primary means of communication between operating units, small hand-held commercial radios were used extensively in a number of critical situations. These non-tactical radios were extremely useful and significantly enhanced teamwork between small units.

- The USS RALEIGH (LPD-1) provided boat haven support which was an essential element of the Navy's Logistics support. LCM 6's were used as Administrative boats and because of their weather sensitivity were required to dock in the RALEIGH'S well as the weather worsened. They completely filled the well deck , and, therefore, the LCM 8's and LCU's were required to transit to Little Creek to obtain a safe haven from the storm. Planning for actual over-the-shore operations must consider this aspect to ensure that adequate facilities and support are available to protect all lighterage under storm conditions. In addition planning must provide adequate logistic resources to service and maintain all of the lighters. The scope of JLOTS II was limited because, for the most part, the Navy cargo lighterage returned to Little Creek for repairs.

3.3.1.1 Organization Relationship

The Service Senior Commander, Commander Amphibious Task Force (CATF) was responsible for directing all USN/USMC units involved in the test. The CATF during the Navy/USMC portion of JLOTS II was Commander, Amphibious Squadron Four (COMPHIBRON FOUR) embarked in USS RALEIGH (LPD-1). There were two phases of command and control during this portion of the test.

The first phase was that period commencing when COMPHIBRON FOUR, as CATF, arrived in the area off Fort Story, Virginia and established an Amphibious Objective Area (AOA). The second phase of the Navy/USMC portion was in effect during the transition period and ended when the Army assumed Operational Control of the test.

During the first portion of the Navy/Marine Corps phase and in accordance with amphibious doctrine, CATF was in overall command with the amphibious task force, Commander Landing Force (CLF), the Naval Beach Group, and the Navy Cargo Handling and Port Group under OPCON of CATF as shown in the top view of Figure 3-51.

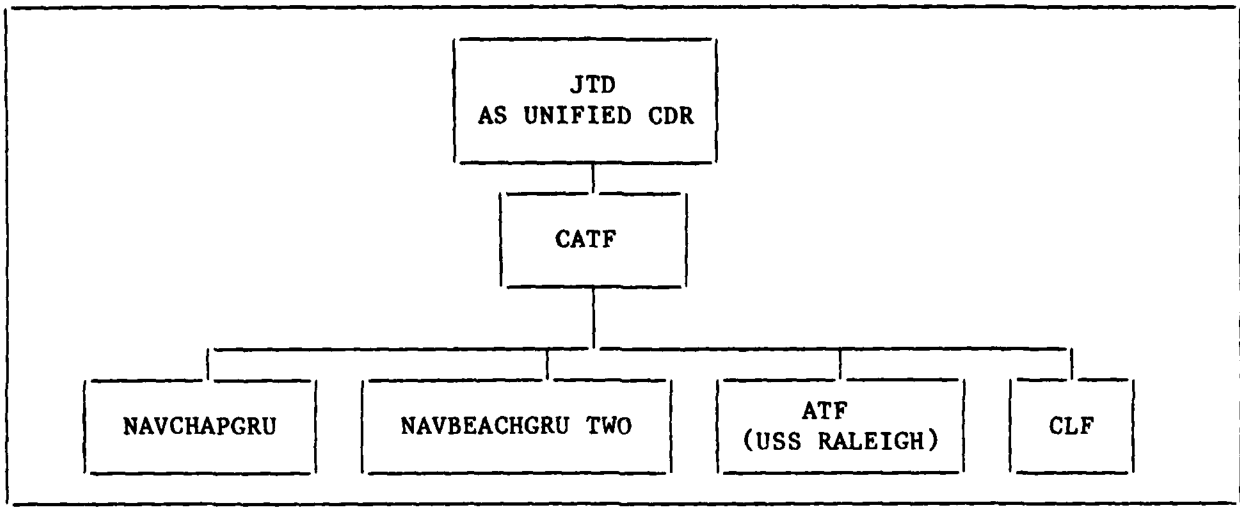
During the second portion of the Navy/Marine Corps phase, the AOA had been disestablished, CATF had become Commander, U.S. Forces Country, Commander, U.S. Naval Forces Country, and CLF had become Commander, U.S. Marine Forces Country. The Army Commander had become Commander, U.S. Army Forces Country as illustrated in the bottom view of Figure 3-51.

During the Navy portion of the test, control of all lighters and other craft in the amphibious objective area off Fort Story was centralized under CO, USS RALEIGH (LPD-1) afloat. Acting as PCS, RALEIGH performed all LCC functions under CATF direction.

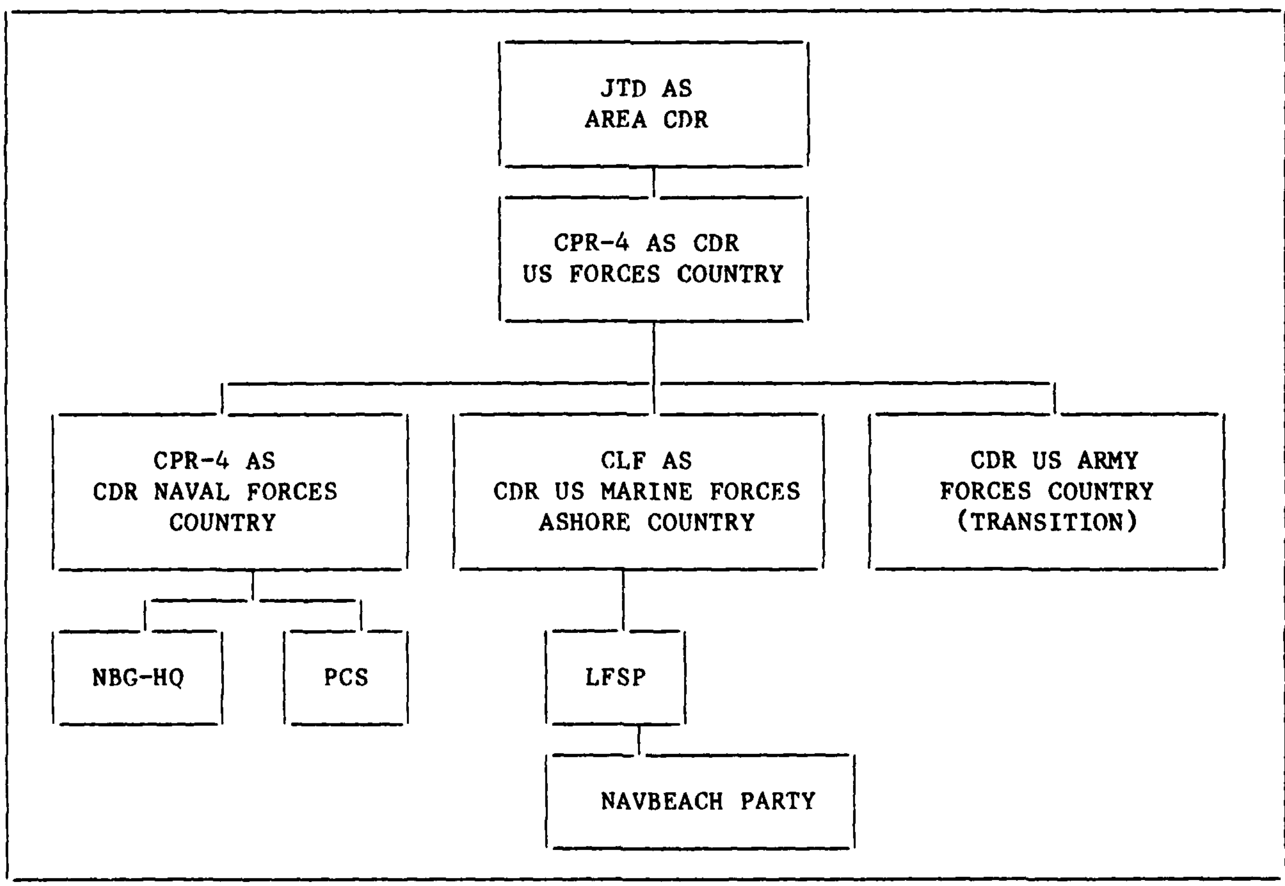
RALEIGH established LCC representatives on the T-ACS and breakbulk ships and with the Beachmaster ashore to insure positive control and efficient employment of all lighterage assets. The LCC representatives on shipping afloat were delegated control over the local movement of lighters to and from loading stations on their respective ships.

The daily USN/USMC personnel for a representative day was as follows:

Command	Officers	Enlisted
COMPHIBRON FOUR	9	15
2nd Landing Support Battalion	21 (USMC)	551 (USMC)
	2 (USN)	20 (USN)
Beach Control Gr Hq	38	513
USS RALEIGH	32	353
NAVCHAPGRU DET P	13	153
TOTAL ON SITE	115	1605



AOA Established



AOA Disestablished

Figure 3-51 - Naval Organization

3.3.1.2 Lighter Control

Control of lighters to and from the T-ACS cargo loading stations and the beach discharge systems was critical to productivity throughout the test. Lighter queuing patterns and location, lighter selections and notification, optimization of mooring approaches and techniques, corrective action for non-responsive lighters, and quick response due to equipment casualties all combine to ensure maximum lighter productivity and minimize lost time at a crane station. It was apparent that overall lighter control, at Primary Control Ship (PCS) for the Navy must be augmented by a local Lighter Control Center (LCC) at the T-ACS. Visual control of lighters during approach, mooring, loading, and departure is absolutely essential.

The T-ACS provided space for the LCC operations (the former bridge deck of the KEYSTONE STATE), and the Services improvised in manning, equipping, and operating the LCC. Doctrine and procedures need to be developed for these local LCC's and published in appropriate service field manuals. Communication capabilities for the LCC and lighters should be enhanced to take advantage of significant strides made in radio communications. Also the LCC space should be improved by the addition of status boards, lights, electrical power outlets, additional table and chairs, and a high command chair. In addition, strong and experienced leadership, especially in the areas of seamanship and knowledge of lighter boat handling and lighter container positioning requirements is needed. In this way the LCC can control all aspects of the lighter moorings and container positioning and eliminate the problems encountered by different lighter crews, each giving their own interpretations to the T-ACS crew. The LCC will always be a key ingredient for success of the T-ACS offloading systems. Such experience can only be gained by utilizing the T-ACS in realistic and frequent training exercises.

3.3.2 Cargo Documentation

3.3.2.1 USMC Manual System

The manual system was based on the container serial numbers, and the system gathered route and location information on the containers as they came ashore and were transferred to and stored in the Marshalling Yard. Location in the Marshalling Yard was identified by row, spot, and tier.

A triplicate form was begun as the container arrived at the beach. This form was given to the truck driver who gave it to a checkpoint clerk at the exit point of the beach where the data center was located. Two copies were returned to the driver who turned it over when checking into the Marshalling Yard. The form was completed with the containers final stowage location in the yard. This information was called in by landline (radio was back-up method) to the data center at the beach. All information was entered by hand onto a listing by container number.

- This system, is limited to container movement and final location. If a certain container is desired it must be searched for by hand through the listing. It was found to be accurate and timely during JLOTS II. However, if a particular item is needed it can only be found by back-tracking a record created at the container stuffing point, finding what containers the item is in, and then searching the listing for where the container is located. This procedure is very time consuming.
- The manual system used the following personnel per shift:

Beach Data Collection	LACH Site	-	1
	RTCH Site	-	2
Data Center (including OIC)			4-5
Marshalling Yard			4-5

3.3.2.2 Marine Automated Cargo Throughput Documentation System (MACTDS)

The prototype MACTDS system fielded for JLOTS II was operated independently from the manual documentation system.

The demonstrated MACTDS system consisted of an IBM 4110 (Green Machine) field computer (and a second for backup), a printer (and a backup printer), and the MACTDS software. These were housed in a trailer at the exit point of the beach road.

During JLOTS II, container movement information was collected on separate forms at the beach and Marshalling Yard. These forms were collected hourly and the combined information fed into the computer.

- This data collection method was slower than that used for the manual system and must be considered a test unique situation. A lag of about 1.5 hr was experienced due to the data collection delays.

- Future improvement considered for data collection includes using the existing techniques of the manual system, or changing to a hand held remote data input system which would input the data directly into the computer from the Field. This would eliminate any time lag in the MACTDS system and would remove an extra step of inputting the data into the computer by hand.

- MACTDS count accuracy was found to be very good. On one occasion the change in shifts confused the container count when data on a container was duplicated. The delay of information on container stowage in the yard was sometimes very long when a shift change occurred before the data was collected. These problems can be worked out by establishing a set data collection routine. They are not faults of the MACTDS hardware or software.

- MACTDS location accuracy was also very good. Container location samples were taken from the yard and checked against the MACTDS record with 100% correlation. Container locations are recorded by row, spot, and tier.

- Recovery of location data was extremely fast. Given a container number, the computer provided its location in an average of 12.3 seconds with about 3 seconds needed to restart to search for another container.

- The MACTDS system was operated in 3 shifts with each shift consisting of the following:

OIC - Computer Operator/Programmer	1
Data Input Clerk	1
Beach Data Collection - LACH Site	1
- RTCH Site	2
Marshalling Yard Data Collection	4

- No capability was demonstrated to interface the MACTDS with the U.S. Army automated system during the transition to U.S. Army control. This capability is considered highly desirable.

Summary. MACTDS represents a great advance in controlling and providing logistics information in the field. It not only tracks the containers from ship to Marshalling Yard, but has in its memory a data base of where the containers came from, who the owning unit is, and their contents (by NSN No.) The NSN of a needed item can be entered, and MACTDS will provide a list of the containers that item is in, and then can locate where these containers are in a matter of seconds.

Accuracy and speed of data retrieval of the system is very good. The data collection method used was test unique since no interaction with the manual system was allowed. Data collection method improvements general control of data input over shift changes and capability to interface with U.S. Army data systems are major areas for improvement.

4.0 TRANSITION

Prior to the JLOTS II test, the typical concept for Transition was described in the following manner.

In a representative contingency situation, the Navy/Marine Corps system would provide the initial commercial ship unloading capability and would deliver not only the follow-on supplies and equipment of the amphibious assault forces, but also the necessary sustained support. Upon arrival of the Army forces, while the Army LOTS system is being established, dual operations would be conducted under Navy control until such time that the Army is fully established and Navy systems begin to withdraw, if required, to support other contingency operations. Control would then shift to the Army using an agreed phased procedure. Early in the transition period, the Navy, Marine Corps, and Army will operate concurrently under Navy control as the Army sets up and begins operating its LOTS system. When mutually agreed and when the majority of Army systems are operational, control will shift to the Army. In any event, the theater commander of the deployed forces would designate those Service provided systems and forces which must be retained in place in order to satisfy daily tonnage requirements.

4.1 TRANSITION OF COMMAND

The Field Test Plan for JLOTS II Throughput Test describes the Transition period expected during the test in a manner very similar to the concept outlined above. "At the point, as designated in the Schedule of Events, approximately eight days into the AFOE cargo throughput operations, the Army commander will commence a phased activation of Army systems at the direction of the Navy commander. These systems will work in parallel with the Navy/USMC systems already in operation to insure no degradation in cargo throughput. The appropriate Naval and Army commanders will arrange for transfer of command responsibility, and a phased deactivation of Navy/USMC systems will begin under the direction of the Army commander. The entire process of 'transition' from the AFOE to LOTS operations should take about four days----. During the Transition Phase, the Navy will arrange for the Army element to operate the Elevated Causeway during Army operations ----."

The Navy Operation Order for JLOTS II (CTU 22.2.2 OPORDER JLOTS II I-84 of 17 August 1984) describes a transition in general terms of a phased activation of Army systems, over a four-day period. It provides for the transfer of command after about two days, and then a phased deactivation and withdrawal of Navy/USMC systems.

The Army Operations Plan for JLOTS II (11th TRANS BN OPLAN AFFG-I-C, undated) gave a detailed day-by-day description of the gradual activation of Army systems and de-activation of Navy/USMC systems. Command control would be assumed by the Army on the morning of the third day of the four-day period.

From the tone of the plans prepared prior to test operations, it is clear that there was agreement on a phased, four-day transition. However, as the test period evolved, delays in the progress of the Navy/USMC operations caused a gradual encroachment on the scheduled period for transition. The published schedule of events (recognized from the beginning to be subject to change) called for transition to begin on 27 September. The Navy/USMC offload of the containership occurring during the period 20-24 September had resulted in a complete offload, but because of various equipment problems, normal test start-up delays, and learning curve experiences, the resulting daily container throughput achievements were not thought by the operational commander to be representative of attainable figures. On 25 and early 26 September, as the backloading operation progressed, the idea of a one-day, "full bore" Navy/USMC offload on 28 September was discussed. Agreement on this approach, with transition to follow, was reached just prior to the unexpected arrival of high wind and sea conditions on the afternoon of 26 September. These conditions triggered immediate decisions to send LCU and LCM lighters to safe haven at Little Creek, and to beach the Causeway Ferries at Fort Story.

Following abatement of the weather and sea conditions, planning for the "full-bore" day was abandoned. The demeanor of the Navy operational commanders in the daily operations meetings changed from enthusiastic commitment to determine cargo throughput capability to a desire to terminate operations at the earliest convenient time. Minimum backloading operations were conducted on 28 September, and no container movement occurred on 29 September. Navy and Army commanders met to plan the transition to be effected, and with Navy lead, a single event transition

was defined. COMPHIBRON FOUR MSG 292330Z SEP84 to the Joint Test Director announced that the transition would take place at 0600 on 30 September. No container movement occurred on 30 September. Sea State 3 conditions existed on 29 and 30 September, so the disruption of container movement cannot be linked to transition related factors. COMPHIBRON FOUR MSG 301800Z SEP84 stated "All USN/USMC command and control functions and operations, both ashore and afloat, terminated at 300600Q SEP84 at which time the CDR 7th TRANS GP automatically assumed those functions ----." The Navy personnel manning the T-ACS Lighter Control Center (LCC) were not able to depart the T-ACS ship until mid-day 1 October, before which they apparently directed a few Navy lighters to the T-ACS for container back-loading. Army LCC personnel apparently did not arrive at the T-ACS before Navy personnel departed.

This analysis of the transition conducted in JLOTS II neither supports or refutes the viability of either the planned or executed transition. The Navy commander's post test report recommends that "wherever possible, command transition should be a single event between all Navy and subsequent all Army operations." The Army commander's after action report says that the transition portion of the test was not fully evaluated, and recommends additional JLOTS type exercises be conducted so that the transition period can be better executed and evaluated.

In both JLOTS I and JLOTS II a phased transition was planned, and in both tests a single event transition was executed. The complexity of the command control situation caused by the different configurations used by the Navy and Army may indicate that the single event transition is easier to implement but may not be feasible depending on operational requirements. The transition phase needs further evaluation.

4.2 TRANSITION OPERATIONS

Since transition was a single event, there were minimum "transition operations". Prior to transition, Army personnel observed operations aboard T-ACS and the Elevated Causeway. One function performed by Army personnel was documentation of the container stow plan aboard the containership as the Navy backload progressed. Army installations of the DeLong Pier and the Amphibian Discharge Site were not conducted as part of the transition schedule, but were done when supporting assets were

available and weather permitted, on a schedule that insured availability when transition would occur.

Promulgation of transition plans to subordinate units seemed to be the primary problem in both the Army and Navy. The daily report of 29 September for one Army unit notes that Transition, Day One, was proceeding according to plan. A log entry of the Navy LCC aboard T-ACS at 0900, 30 September states that information was just received from the Navy command ship that the Army had assumed operational control of the LCC as of 0600 that date. The log further notes that there was no Army team aboard. This apparently was the first information the LCC received concerning transition. The final log entry for the Navy LCC aboard T-ACS was made at 1105 on 1 October, when a Navy craft was moored alongside to pick up the Navy personnel. Between 0432 and 1105 on 1 October there were log entries indicating confusion over whether or not the Navy LCC personnel should leave their communications equipment aboard the ship when they departed.

The Staff Watch Log aboard the Navy command ship noted at 0606 on 30 September that Army Operations had assumed JLOTS command and control. At 0620 communications with Army Operations had been established and attempts were being made to confirm that lighterage communications could shift to the Army LCC. There is no indication that Army LCC was activated before Navy control terminated.

Army container backloading operations at the T-ACS commenced in the afternoon of 1 October.

Transition operations were affected by a combination of factors. First, the weather and sea conditions had disrupted cargo operations, thus there was no measure of transition effects on cargo flow continuity. Second, the original plans for a four-day phased transition were never completed in detail by the Navy, so there never was a well understood transition procedure. Third, the single event transition that evolved lacked details and was not communicated to all the subordinate commands in a time frame or manner that could be well coordinated.

5.0 ANALYSIS, DISCUSSION, AND DETAILED CONCLUSIONS (Army)

The 11th Transportation Battalion was designated by the 7th Transportation Group as the Task Force for the Army portion of the JLOTS II, Phase III, exercise. Other participating Army units consisted of:

- 8th Transportation Company (ACV)
- 309th Transportation Company (HA)
- 331st Transportation Company (ACV)
- 368th Transportation Company (TS)
- 549th Quartermaster Company (PO)
- 10th Transportation Company
- 119th UPT Company
- 497th Engineer Company
- 491st Transportation Detachment (Cargo Documentation)
- 16th Quartermaster Company (FS)
- 109th Quartermaster Company (PO)
- 440th Medical Detachment
- *24th Infantry Division*

It was the purpose of JLOTS II to demonstrate the Services' capability to conduct sustained throughput operations in an atmosphere that simulated an actual AFOE/LOTS scenario. It was expected that some learning would be required on the part of the troops to familiarize themselves with the T-ACS. It became evident that the Army personnel had little experience with this type of operation. Consequently, the operation served largely as a training exercise.

5.1 INSTALLATION AND PREPARATION

Commencement of Army operations required no further installation of the already installed T-ACS/containership, breakbulk ship, and elevated causeway. The T-ACS crane operators were the same for both Army and Navy because they were part of the ship's complement.

The installation and preparation of Army systems treated in this discussion and analysis are: TCDF, beach roadway and support facilities modifications, DeLong Pier, Amphibious Discharge Site, ROWPU, and the bulk petroleum products systems.

5.1.1 Offshore-TCDF

One TCDF (BPL 6703) was initially moored to the EXPORT LEADER during the night shift on 15 October. Rough seas forced the TCDF to pull away to an anchorage until the next mooring when a second TCDF (BPL 6702) arrived. Moorings were accomplished on 16 October as shown in Table 5-1.

TABLE 5-1 - TCDF MOORING TIMES

TCDF	Date	Mooring Start Time	Mooring Complete Time	Mooring Location
BPL 6703	10/16	0828	0842	EXPORT LEADER port
BPL 6702	10/16	1006	1020	EXPORT LEADER starboard

BPL 6702 was equipped with a Rider Block Tagline System (RBTS) for load pendulation control.

Mooring lines passed between the EXPORT LEADER and TCDF's were managed by four line handlers on each TCDF. Fenders on BPL 6703 consisted of four LARC tires. BPL 6702 fendering consisted of one cylindrical fender forward and six truck tires along its port side. BPL 6702 fendering did not afford adequate protection as the wave induced motion caused metal-to-metal contact between the TCDF and the EXPORT LEADER. Figures 5-1 and 5-2 show the fendering systems employed.

5.1.2 Onshore Installation and Preparation

5.1.2.1 Beach Preparation

General. During transition from Navy/Marine Corps to Army throughput operations, the beach was cleared of all Navy/Marine Corps equipment (rolling stock, tents, etc.) and replaced by Army equipment. The Navy ELCAS and the beach roadway system remained.

The Army then installed several operation/command centers (tents) on the beach and upgraded and expanded the roadway system.

Time. Army beach preparation was not a timed event.

Figure 5-1 - LARC Tire Fendering System on BPL 6703

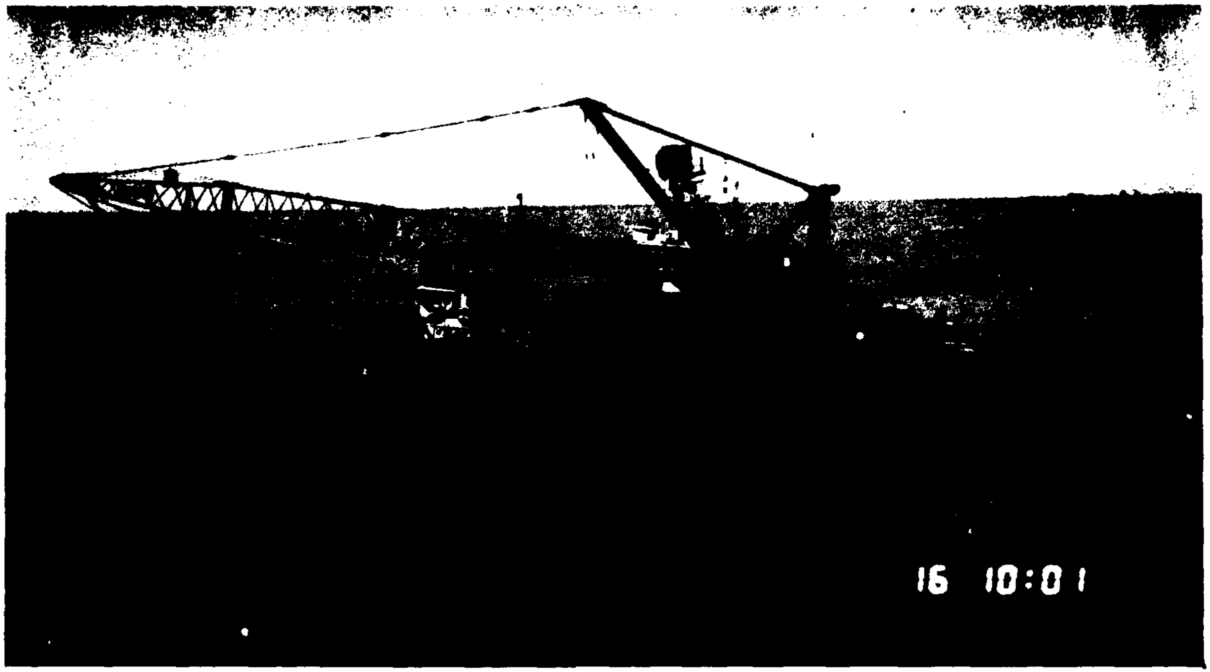


Figure 5-2 - Truck Tire Fendering System on BPL 6702

Manpower. Tent installation was accomplished by Army personnel. Roadway maintenance and expansion was performed primarily by Public Works personnel under Army direction.

Equipment. The primary equipment was MOMAT, dozers, and forklifts.

Procedures. The Army modified the Navy/Marine Corps roadway system as can be seen by comparing Figures 5-3 and 3-7.

Area (1) is an added MOMAT area to facilitate truck turnaround and loading at the Amphibian Discharge Site.

Area (2) is the Amphibian Discharge Site formed by piling sand in the form of a horseshoe to guide the LACV-30 into its offload position under the cranes. The berm, approximately 10 ft high, also reduced the problem of blowing sand during LACV-30 operations. The berm configuration was altered during the test to improve LACV-30 operations as experience was gained, and it required continual leveling by dozers throughout the test to correct erosion from storms and from the erosive action of the LACV-30 cushion air flow.

Area (3) is a diagonal MOMAT road which allowed trucks, loaded at the DeLong or ELCAS, to exit the beach avoiding the deteriorated Sand Grid of

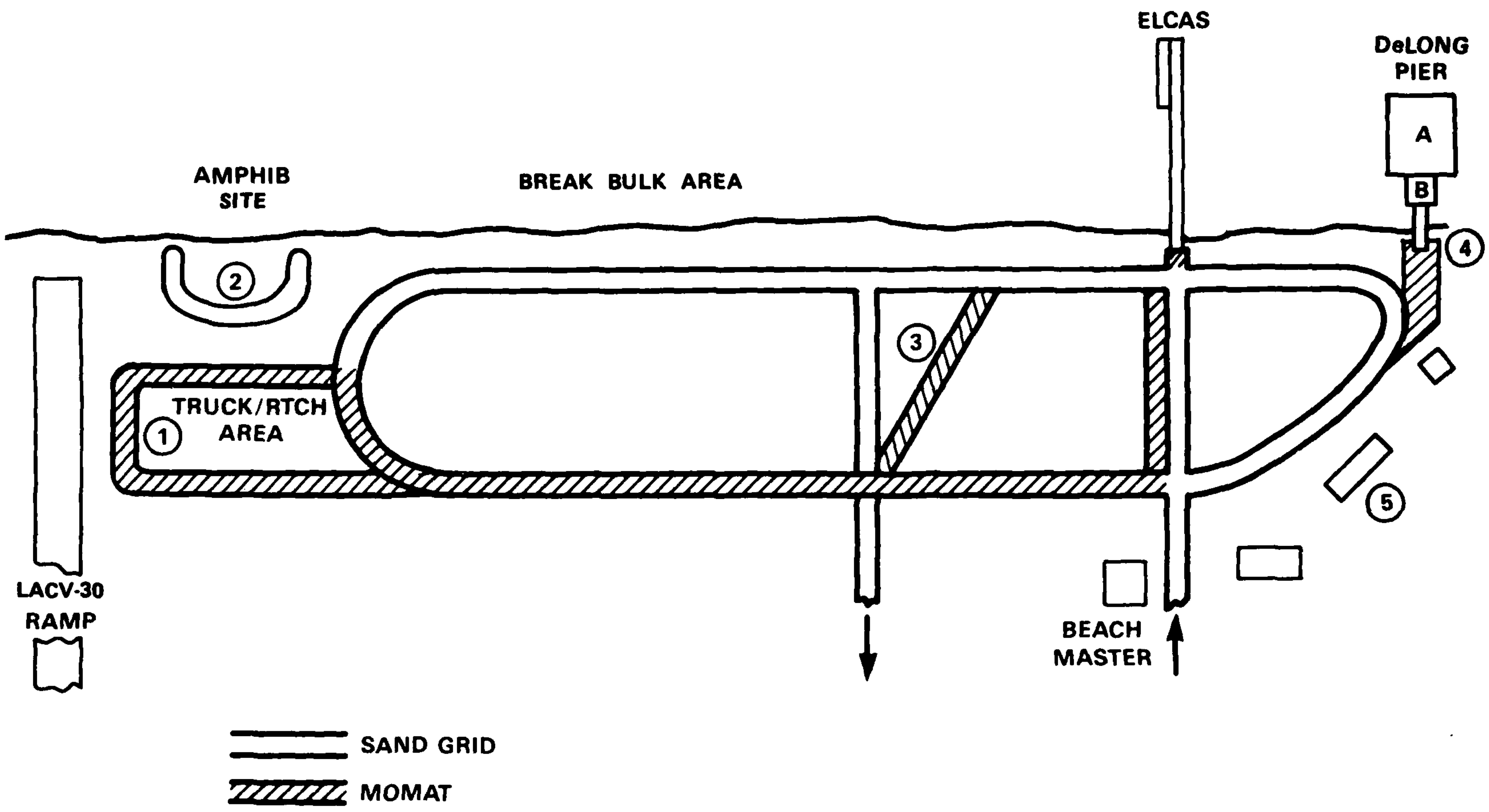


Figure 5-3 - Beach Layout - Army Test

the original route. The diagonal roadway also reduced congestion between DeLong/ELCAS trucks and trucks servicing the breakbulk areas.

Area (4) is a MOMAT approach to the DeLong ramp. It overlapped the original Sand Grid at the eastern end of the race track. The DeLong ramp rests on an abutment formed by dozing sand into a mound.

Area (5) is the added command/control area.

At the completion of the Navy/Marine Corps operations, the existing roadway was in need of extensive repair and maintenance. Public Works was tasked by the Army to:

- Maintain the sand bed under the MOMAT (keep it level) on a continuous basis throughout the remainder of the test.
- Attempt repair on deteriorated sections of Sand Grid. Clay gravel was packed into holes in the roadway. This patching tended to deteriorate rapidly and had to be reworked periodically.
- Clear the beach of MOMAT and Sand Grid debris left after storms destroyed the section of roadway along the beach between the ELCAS and the Amphibious site.

Environment. High tide, wind, and storms caused considerable damage to the beach system and forced the Army to re-work some of its initial beach installation.

- High water undermined the Area (1) MOMAT. It had to be re-bedded.
- The Amphibian Site, Area (2), was heavily eroded several times and had to be re-shaped. Major erosion occurred from water intrusion during storm generated high tides. Erosion also occurred because of the propeller wash and cushion air flow from the LACV-30 operations. Erosion was not uniform and tended to create a slope in the LACV-30 track.
- The diagonal MOMAT road, Area (3), was installed primarily because of water damage to the Sand Grid. Figure 5-4 shows the effect of storm tides on the Sand Grid West of the ELCAS.
- The abutment under the DeLong ramp was washed out as shown in Figure 5-5 and had to be rebuilt. Rocks, concrete chunks, etc., were packed around the surf side of the abutment to inhibit further erosion from tide and current (see Figure 5-6).

Conclusions.

- Continual maintenance of the roadway system is essential to prevent a breakdown in beach operations. Once the roadway disintegrates locally,

Figure 5-4 - Storm Damage to Sand Grid

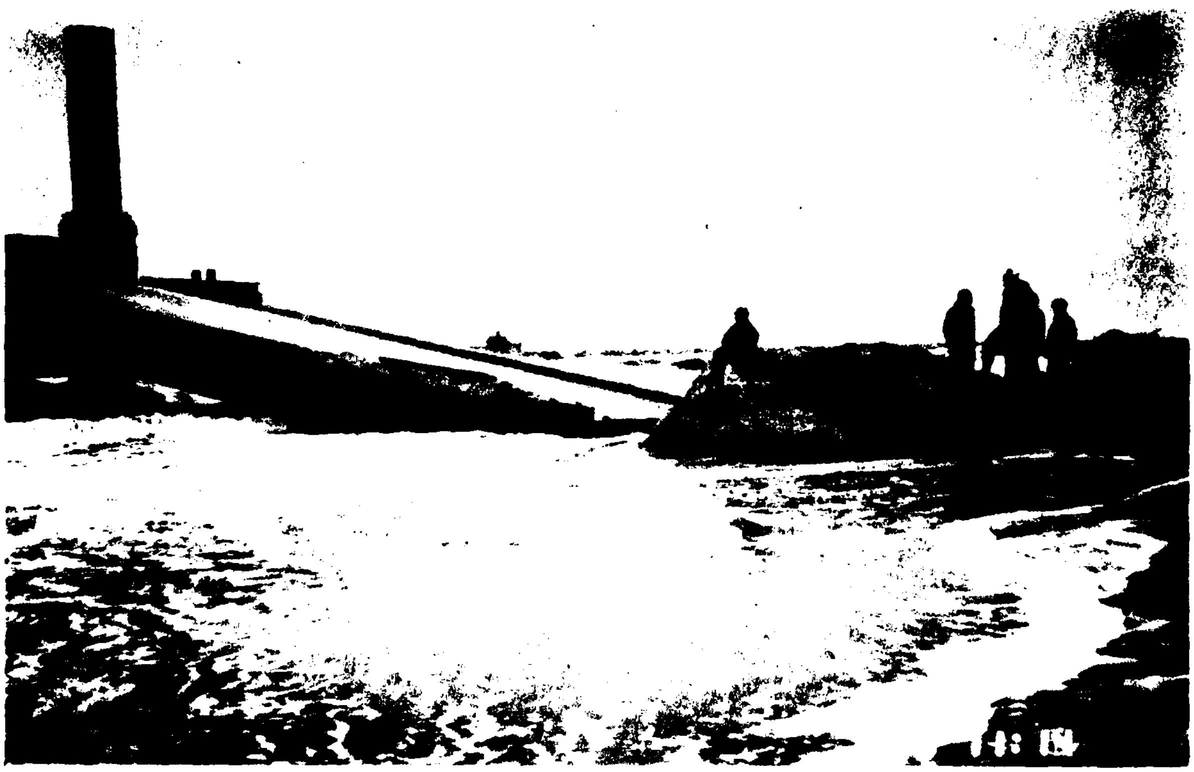


Figure 5-5 - Storm Damage to DeLong Ramp Abutment

Figure 5-6 - Rubble Protection for DeLong Ramp Abutment

truck traffic must stop. MOMAT maintenance is relatively simple and can be accomplished by a dozer and several personnel to roll and unroll the mat.

Sand Grid maintenance is not as simple. The temporary repair technique used was to pack clay gravel into holes. This did not hold up. Overlaying MOMAT would be more effective.

- The DeLong ramp abutment should be heavily coated with sandbags, rocks, etc., wherever high water is expected. Beaching the B-DeLong at peak tide would allow constucting the abutment as far away from the reach of the tide as possible.

- The lighter track of the Amphibian Discharge Site must be kept flat for stable LACV-30 maneuvering. It is difficult to position the craft over uneven ground.

5.1.2.2 DeLong Pier

General. Installation and preparation of systems and facilities operated in JLOTS II was, according to the Test Design, to begin with equipment in the configuration expected on its arrival following movement to the operating area (deployment). During preparations for the JLOTS II Deployment Test, a technical investigation concluded it is infeasible to

transport a B-DeLong Pier aboard a SEABEE ship with caissons in place, and it is infeasible to transport a 100-ton BD crane (the Army preferred equipment for inserting caissons in the DeLong jacks/wells) aboard the SEABEE. The A-DeLong Pier is not transportable aboard currently available U.S. Flag shipping.

The A-DeLong Pier used in JLOTS II was towed across the Atlantic Ocean. Caissons were not in place during the crossing.

Therefore, it appears to be a requirement that the caissons be inserted in the pier jacks/wells during pier installation and preparation in the operating area. The capability to deploy equipment suitable for this task was not evident. A deficiency thus exists in the ability to prepare and install a DeLong Pier.

The A and B-DeLong Piers were towed to the test site from Fort Eustis with their caissons already installed. Army tugs towed the piers into the operating area.

Time. The installation of the DeLong Pier was not a timed event. However, maneuvering the piers into position took many attempts over a 24-hour period because of the high current and the limited propulsive power to control them in the high currents and wind. Once positioned, each pier required about one hour to elevate.

Construction of the original abutment for the ramp was done prior to arrival of the B-DeLong Pier and required about one hour.

Deploying the ramps required about one hour.

Manpower. Manpower required to install the DeLong Piers is itemized below.

Offshore	-	4 - LCM-8 Crews
On the Piers	-	1 - OIC 1 - Crane Operator 1 - Signalman 4 - Jack Operators
On the Beach	-	1 - Director 2 - Dozer Operators 1 - RTFL Operator 1 - Crane Operator

Equipment. The equipment required to install the pier is itemized below:

Offshore	-	4 - LCM-8's
On the Piers	-	1 - Crane 4-6 - Pneumatic Jacks 1 - Air Compressor
On the Beach	-	1 - Crane 2 - Dozers 1 - RTFL

The crane on the B-DeLong Pier and on the beach worked together to deploy the ramp. The two dozers built the ramp abutment by scooping sand from a wide area to minimize the resulting depression around the abutment.

Procedures. The installation of the B-DeLong was as follows:

- The Army tugs towed the pier to a position about 300 yd off of the intended beaching spot at the east end of the race track roadway system.

The pier was transferred from the tugs to two Army LCM-8's (Figure 5-7) which were to provide the power to bring the pier to the beach. The two LCM-8's did not have sufficient power to hold the pier against the wind and current from the east while making a course into the beach and could not beach the pier at the intended beach position.

Figure 5-7 - B-DeLong Pushed to Beach by LCM-8's

• After drifting west past the ELCAS, four LCM-8's were secured to the pier (two per side) and it was beached about 50-ft west of the intended position. The pier was anchored for the night by lowering the caissons into the sand.

• The following day several more attempts were made to beach the B-DeLong Pier in position opposite the already constructed ramp abutment. This was finally achieved at 1510 on 19 September.

• The B-DeLong Pier was elevated in approximately one hour by jacking its four caissons into the sand using its pneumatic jacks.

• The ramp was initially deployed using the onboard crane to lift the seaward end and an onshore crane to lift the beach end and set it on the pre-formed abutment. The ramp placement had to be redone several times because of the erosion of the abutment during high tides.

Subsequent ramp positioning was accomplished using a 10,000 lb RTFL to lift the beach end of the ramp while the B-DeLong crane lifted the seaward end (Figure 5-8).

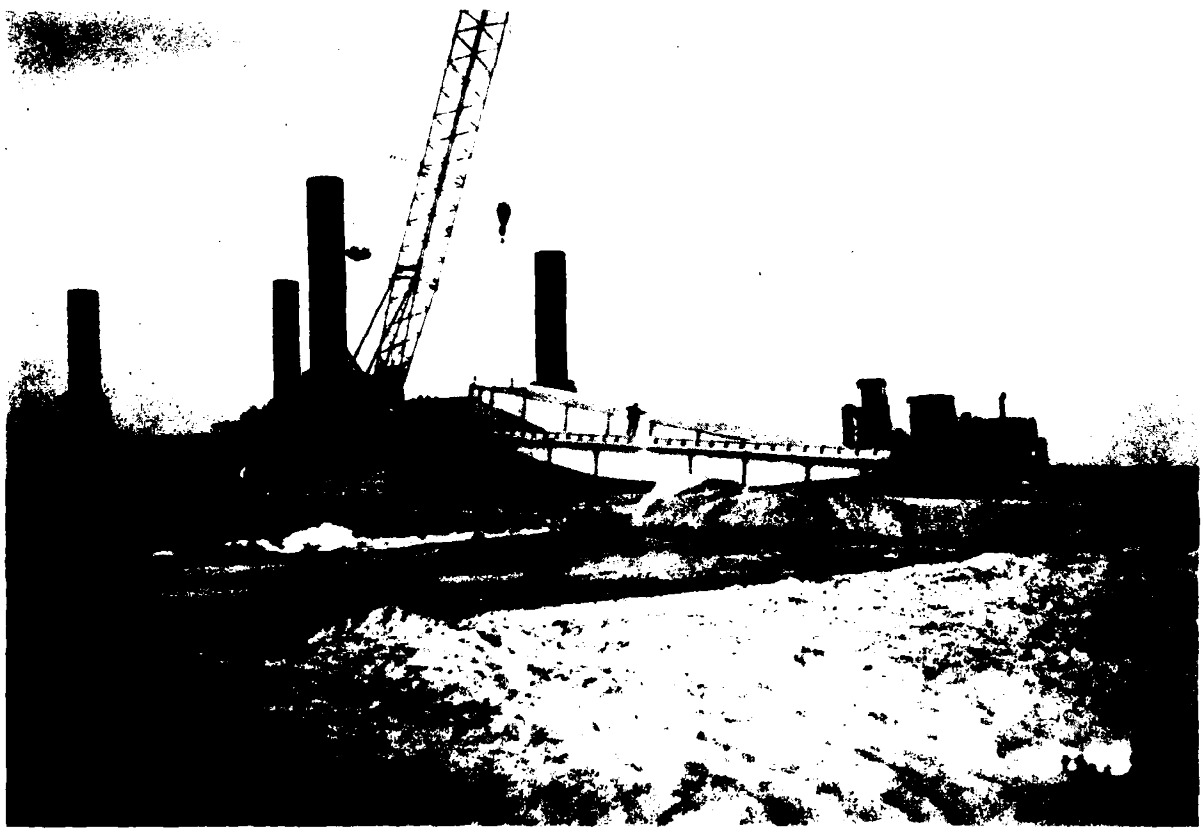


Figure 5-8 - DeLong Ramp Installation

• The A-DeLong Pier installation experienced similar difficulties with the wind and current. It was positioned at the seaward end of the B-DeLong and raised so that its deck was level with the B-DeLong Pier.

• After raising the two piers into operating position (bottoms above surf), large cylindrical fenders were lowered over both sides of the A-DeLong and secured.

Environment. Current and wind caused the most difficulty during the DeLong installation. The tow power of the 4-LCM-8's was marginal under the high current and wind which existed during the installation activities.

Conclusions.

• Installation of the DeLong Piers should be performed at high tide during minimum current conditions. This would improve the capability of the LCM-8's to control the pier during beaching and would allow the pier to be beached as high as possible to minimize the occurrences of the tide eroding the base of the ramp abutment. If unable to schedule the installation for minimum current conditions, then more power units should be moored to the pier to insure positive control.

• The undemonstrated ability to install caissons in the jacks leaves doubt that this facility can be utilized in a contingency area where erection equipment is not available.

• Deployment of the ramps from their stowage on the deck of the B-DeLong Pier required the use of a crane and, subsequently, a RTFL on the beach. Proper planning should account for deployment of such equipment when the DeLong facility is to be utilized.

• The slippery surface of the steep ramp made it difficult for trucks to climb, because of marginal power 2-wheel vice 4-wheel drive tractors and because of a lack of traction. Consideration should be given to deploying the ramp at a shallower angle and coating it with a rough surface. Figure 5-9 shows a RTFL assisting a loaded truck up the slippery ramp during a backload operation.

• The cylindrical fenders were tossed against the side of the pier by wave action and this rapidly delaminated their rubber coatings as seen in Figure 5-10. RTCH tires were subsequently used and provided satisfactory fendering.

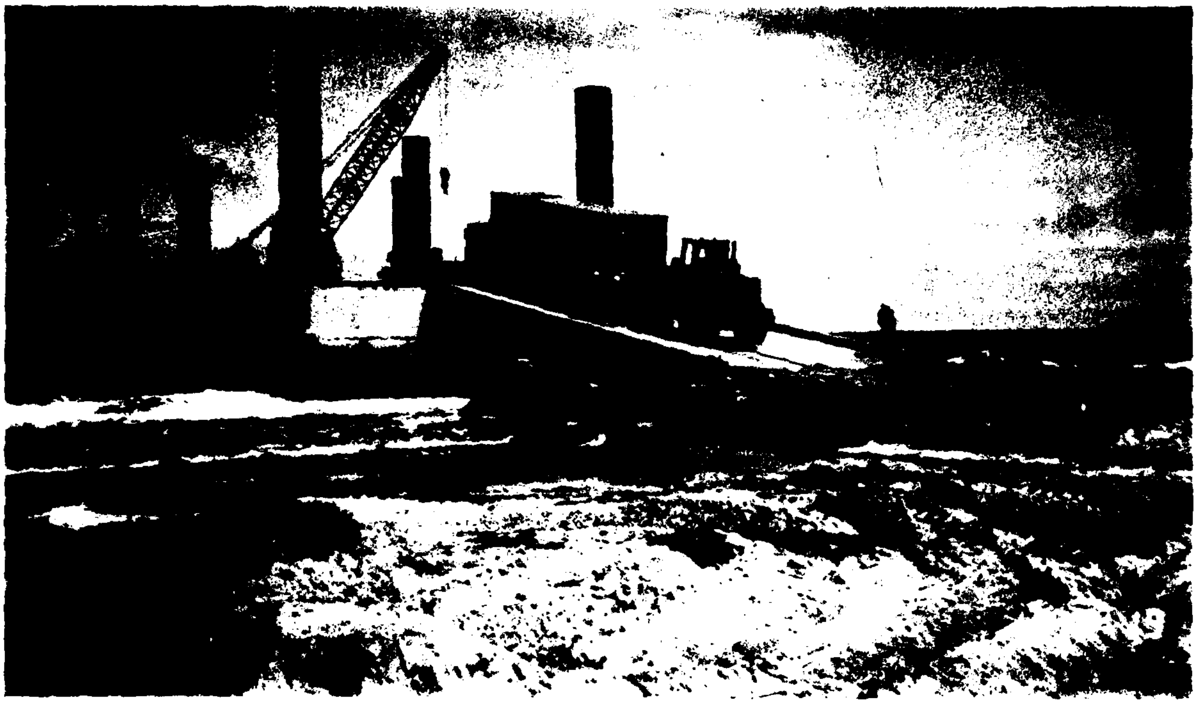


Figure 5-9 - RFTL Assisting Truck on DeLong Ramp

Figure 5-10 - Fender Damaged at DeLong Pier

• Life jackets should be worn at all times. Line handlers operating close to the unprotected sides of the pier could easily be pulled or blown overboard.

5.1.2.3 Amphibian Discharge Site

General. The Amphibian Discharge Site consisted of a horseshoe shaped sand berm at the water's edge with the open side of the horseshoe pointing seaward. The berm was approximately 10-ft high and was formed by dozing the local beach sand. One function of the berm was to provide a "wall" to accurately guide the LACV-30 to either of the two container offload positions. Another function of the berm was to minimize blowing sand during LACV-30 operations.

The initial berm configuration had two "islands" in the entrance of the horseshoe. These islands formed "entrance gates". During the course of the test, storms eroded the islands away until only the basic horseshoe berm remained. This arrangement proved to be more satisfactory than the original configuration. The tide tended to erode the seaward reaches of the berm and LACV-30 cushion air flow eroded the maneuvering area within the berm. The berm and the enclosed area had to be continually repaired and leveled.

Figure 5-11 shows the position of the two container handling cranes, the MOMAT truck-loading zone behind the berm, and the RTCH parking area and container stowage area. Constant maintenance was required to keep the MOMAT in position and level.

Time. The berm construction was not a timed event.

Manpower. The manpower required to build the berm consisted primarily of several dozer operators and an OIC.

Equipment. Dozers, forklifts.

Procedure. The berm was dozed from the local beach sand. The sand was scooped from a broad enough area so as not to leave a noticeable depression around the berm.

Environment. The environment did not pose difficulties during the installation of the amphibian discharge site. Subsequently, major erosion resulted from storms and high tides.

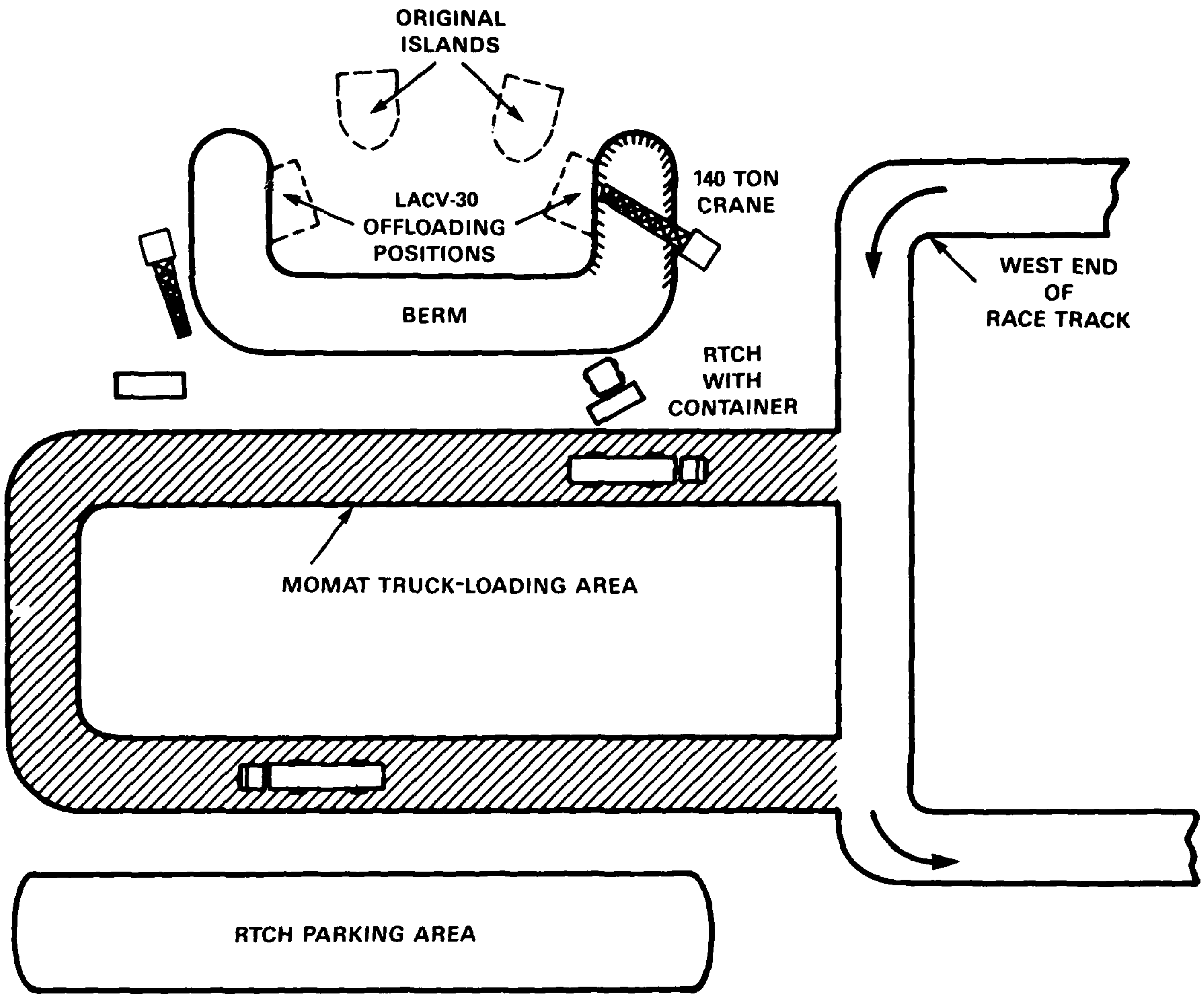


Figure 5-11 - Amphibian Discharge Site

Conclusions.

- Operating experience demonstrated that the site should consist of a simple open horseshoe berm without the "islands" in its entrance.
- The site should be set farther back from the water's edge to reduce intrusion by the tides.
- Constant maintenance is required to maintain a level LACV-30 track in the sites.

5.1.3 Bulk Liquid System Installation Preparation

5.1.3.1 ROWPU

General. The ROWPU barge and hose to the beach was installed twice during JLOTS II. The first installation was performed on 18 and 19 September and the second on 20 September. The second installation was performed because of the poor performance of the crew and rough weather during the first installation. The entire crew had received insufficient training prior to JLOTS II and the civilian project manager and contract personnel assisted in directing crew efforts. The result was that this was more of a training exercise than an operational demonstration.

The transfer of personnel to/from the barge was dangerous and found to be best accomplished using a LARC-LX.

Time. Table 5-2 presents the installation times by major events.

TABLE 5-2 - ROWPU INSTALLATION TIMES

Date	Time	Event
		1st Installation
9/18/84	0930-1305	Deployed 3 anchors
9/19/84	0805-0825	Deployed 4th anchor
	1155-1525	Deployed hoseline
		2nd Installation
9/20/84	1510-1715	Deployed 4 anchors
	1715-1950	Deployed hoseline

The first installation was hampered by Sea State 2-3 conditions and mechanical failure on the LCM-8 and 100-ft tug support craft. Actual work time during the first installation included approximately 3 hr and 20 min to deploy 4 anchors and 2 hr and 40 min to deploy the hoseline. During the second installation, anchors were deployed in about 2 hr and the hoseline was deployed in about 2 hr and 30 min.

Manpower. Table 5-3 depicts the manning of the ROWPU barge and the beach winch.

TABLE 5-3 - ROWPU INSTALLATION PERSONNEL

Location	Description	Grade	MOS	No. on Hand	Unit
ROWPU Barges	Water Purification Spec	E-5	51N	3	26th EN Detach 277 GS Co. 561st Bn. Ft Campbell, KY
	Water Purification Spec	E1/4	51N	7	
	Plumber	E-5	51K	1	
	Plumber	E1/4	51K	1	10th Trans Bn. 7th Grp Ft Eustis, VA
	Plumber	E1/4	61B	1	
	Water Craft Engineer	E1/4	61C	1	
Winch on Beach	OIC	Capt		1	6th Trans Bn. 497 En Co.
	Construction	E1/4		4	
TOTAL				19	

Equipment. Table 5-4 lists the equipment used to install the ROWPU barge system. The barge is very susceptable to roll and pitch which greatly increases the difficulty and risk of many of the installation steps. Personnel transfer to/from the barge is very risky and was finally done using a LARC-LX. The anchors are stored on davits and must be swung over the side using the hand-operated davit winch and attached to the electric winch cable. This is an extremely difficult and dangerous task since there

TABLE 5-4 - EQUIPMENT USED DURING ROWPU INSTALLATION

Item	Quantity
ROWPU Barge (w/4 anchors and winches)	1
100-Ft Ocean-Going Tug	1
LCM-8	1
6,000-Lb Winch (w/anchors and screen)	1
17-Ft Personnel Boat	1
LARC-V (personnel transfer)	1
LARC-LX (personnel transfer)	1

is no way to control swinging of the davit if the anchor is loose. The davit winch is hand operated and in an awkward position (Figure 5-12).

The electric anchor winches could not be allowed to free wheel when paying out line. This caused delays and unnecessary difficulty in using the LCM-8 or tugboat to carry the anchors from the barge to their deployment location

The 17-ft boat used to deploy the KEVLAR messenger line to the beach was dangerous to launch and performed inadequately in anything over a Sea State 1. This line is needed to pull the hoseline to the beach. The boat was swamped on the beach while transferring the KEVLAR line to shore during Sea State 1 to 2 conditions (Figure 5-13). A LARC would provide a much safer platform for performing this task. If a LARC is not available the system should be modified so the line reel is left on the barge and the line end shot from the boat to the beach.

Procedures. Many of the problems which occurred during the first installation were due to a lack of training of the crew. During the second installation, weather conditions had subsided and the crew was more knowledgeable.

Figure 5-12 - Operation of Davit Winch

Figure 5-13 - 17-Foot Boat Swamped on Beach While Transferring KEVLAR Line

Major problems which occurred during the two installations were:

First Installation

1. The tug had the barge in tow rather than alongside and could not control it properly when positioning it. The tug's radar was used to get the position distance from the beach. The radar sighted on the dunes behind the beach, however, so the barge was closer to the beach than desired.

2. The tug disconnected from the barge prior to deploying the anchors. A downstream (relative to the current flow) anchor was dropped first rather than an upstream anchor.

3. Sea State 2-3 conditions and a strong current hindered the attempts by an LCM-8 to move the barge and properly install the upstream anchors (Figure 5-14). The LCM-8 blew an engine after the third anchor and a 100-ft tug installed the fourth anchor the next day (19 September).

Second Installation

The KEVLAR line is run through several fairlead sheaves on the beach to align it with the winch drum. These sheaves are anchored in place with 6-ft steel stakes which began to pull out when the end of the hose dug into the sand as it was pulled onto the beach. This halted winching

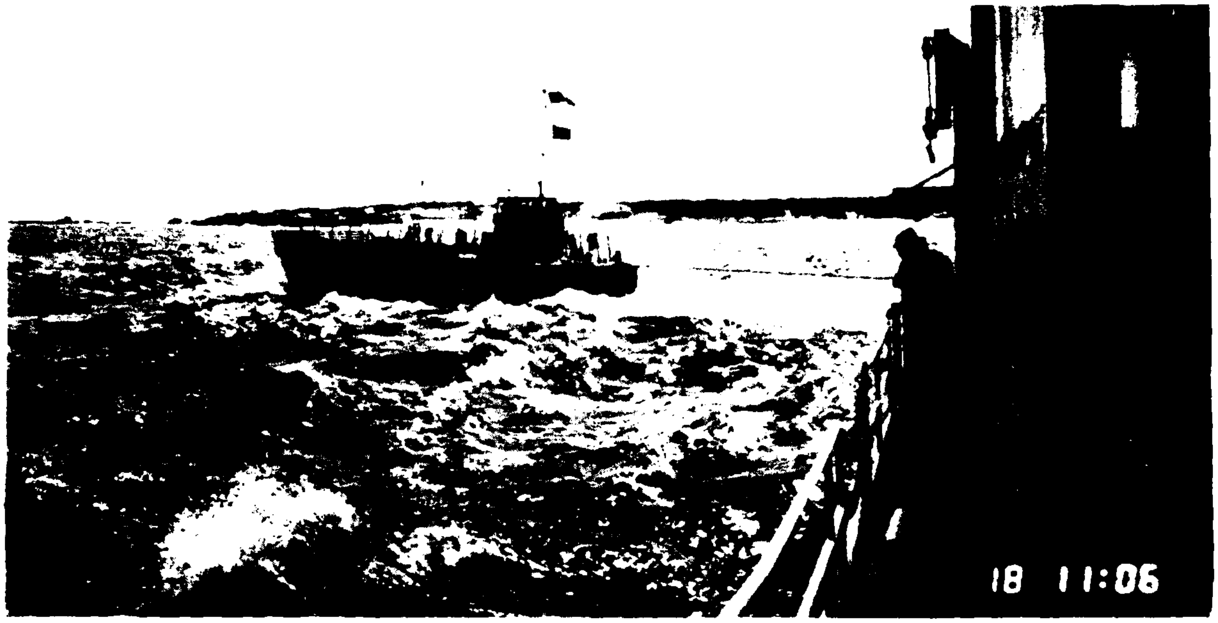


Figure 5-14 - LCM-8 Attempting to Pull ROWPU to Anchoring Position

operations with the end of the hose still in the surf zone. In this case, no difficulty was experienced in extending and connecting the beach system hose to the barge hose. However, if high surf conditions existed or if the length of the beach system hose was fixed, this could cause problems.

Environment. Sea State 3 conditions prevented any attempt to install the ROWPU on 17 September and Sea State 2 conditions made operations on the barge extremely dangerous on the 18th. The handling of the anchors while hanging from their davits was very hazardous because the rolling of the barge caused them to swing when being deployed to the LCM-8.

Once the anchors were set, the 17-ft boat was launched over the side by a winch on an overhead rail. Installing this rail from the roof of the barge house and then swinging the boat over the side while the barge was rolling put personnel in very dangerous situations. The boat is deployed from the starboard side of the barge which was fully exposed to the waves after the four anchors were set.

Summary. The ROWPU barge can be placed into operation in calm water well within the 24-hr limit set for it by the Army. However, if Sea State 2 conditions exist, a LARC may be required instead of the 17-ft boat. The anchoring of the barge was partially accomplished during Sea State 2-3, but

it is doubtful that the hoseline could be installed during a Sea State 3 without modifying the equipment and procedure as discussed above.

5.1.3.2 Tactical Marine Terminal (TMT)

The TMT deployed for JLOTS II consisted of a 6-in. floating hoseline, a 6 in. steel bottom-lay pipeline, a spread mooring/anchorage of four-drag embedment anchors and on onshore storage and delivery system. Each of these is discussed below.

5.1.3.2.1 Six-Inch Floating Hoseline

General. The 3700 ft of hoseline installed had been borrowed from the Navy because the Army units hoseline was 'unserviceable'. The borrowed hoseline had been designated for disposal and no water pressure test had been performed. Spare parts were not obtained for maintenance or repair.

Time. The installation of the floating hoseline required 1.2 hr on 2 October, 1984.

Manpower. The hose was installed by approximately 40 members of the 497th Engineer Company with assistance by an LCU and 2 LCM-8's.

Equipment. Table 5-5 lists the equipment used during this installation. The 3700-ft of hoseline deployed was anchored every 150 ft with 40-lb drag anchors vs the optional 150- to 200-lb drag anchors. This allowed large movement of the hoseline by the strong tidal currents present at Fort Story. Movement of the line was estimated at several hundred feet with every tide change, which could eventually result in failure of the hose.

TABLE 5-5 - EQUIPMENT FOR 6-INCH FLOATING HOSELINE INSTALLATION

Hose 6-In. Floating	3700 Ft
Hose Reel (with 40-lb anchors)	1
LCU	1
LCM-8	2
Bulldozer	1

Flashing marker lights were attached every 150 ft during installation. When the majority of the hoseline later sank because of leaks, the light either pulled off or failed, which left the hoseline with no marker lights.

Procedures. The hose reel was placed in an LCU and hose was deployed out over the stern. In the beginning, the beach end was wrapped around the side of the LCU to the bow. The LCU moved to the beach bow first. A line was shot to the beach from the LCU and a 150-ft messenger cable pulled ashore and attached to a bulldozer. This method worked very well and avoided sending a craft or personnel through the surf zone. It is a recommended procedure for deployment of any system where a line crosses the surf.

The bulldozer pulled the end of the hoseline to the waterline on the beach. There was no cap on the end of the hose and it scooped sand and sea water an it was pulled ashore. The end of the hose was left in the surf zone on the beach which would make it difficult for connecting to the shoreside storage system during high tide or high surf.

After the bitter end of the hoseline was pulled ashore and secured using the bulldozer, the LCU then backed away from the beach and pivoted 180 deg (with assistance of two LCM-8's) before proceeding seaward with the hose paying out over the stern. This method is much riskier than the procedure of leading the hose over the bow and the LCU backing all the way to the tanker anchorage. Assistance of the LCM-8's is necessary to keep the LCU on line in strong crosscurrent. This was only partially successful and the last 1500 ft of hoseline was deployed almost parallel to the beach to get the seaward end to the correct location.

While deploying the seaward-end of the hose, the marker buoy came loose and the end of the hose sank. It was later recovered by divers and the buoy was attached.

A large amount of water had entered the hoseline from leaks causing it to sink. The hose was then pressurized from the beach end to remove the water, but the end cap was not removed, so the water was pushed to the end, but not out. Several air leaks were spotted at fittings during this test, but no repairs were attempted since no spare parts were available.

Environment. The hoseline was originally scheduled for deployment on 1 October, but the installation was held off due to Sea State 3

conditions. On 2 October, a Sea State 2 existed with winds up to 20 knots and a crosscurrent of approximately 1 knot. The current and wind combined to push the LCU off line in spite of the presence of two LCM-8's and, a large portion of the hoseline was deployed just to get the end to its required location.

Summary. The floating hoseline was installed in a fairly short time. However, some of the procedures used were unorthodox and should not be considered standard.

- The hose should be tested and repaired prior to use.
- The ends should always be capped before installation.
- The beach end should be pulled well up above high waterline.
- 150- to 200-lb anchors should be installed along the length.
- The buoy on the sea end must be well secured prior to launching.
- Special lights (similar to those for the Navy floating hose) should be utilized for night marking.
- A pressure test (and clearing the hose with air if necessary) should be performed after installation.
- The effect of a strong crosscurrent must be considered for installing and anchoring the hoseline.

5.1.3.2.2 Six-Inch Bottom-Lay Pipeline

General. The beach area was prepared and the installation performed by the 497th Engineering Company. Approximately 3450 ft of pipeline was installed on 21 September.

Time. The times required for beach preparations and pipeline installation are presented in Table 5-6. A two-hour delay occurred while straightening a kink in the anchor wire of the barge that was used to pull the pipe.

While pulling the pipe out to the MLMS anchorage, a conflict arose with PHIBCB personnel who were planning to put their floating hose in approximately the same location. The resulting delay is not included in total installation time calculated. The disagreement was resolved by the JLOTS staff.

Manpower. Beach preparations required 10 personnel while installation of the pipe required 16 personnel on the beach and a crew of 5 on the barge. An LCM-8 attended the barge.

TABLE 5-6 - INSTALLATION TIME OF THE SIX-INCH BOTTOM-LAY PIPELINE

Hours Required	Event
9.0	Beach preparation by dozers.
1.0	Install pipe tongs.
4.0	Install pipe rollers, cribbing, and stack pipe.
7.0	Assemble pipe in 90-ft sections.
1.0	Attach riser hose to pipe.
2.0	Delay to fix kink in anchor line of barge and to coordinate with Navy on correct location.
0.5	Move Cube Barge to shore end, attach to pipeline riser hose.
0.3	Delay to reset pipeline pulled off track by Cube Barge which is pulled sideways by current.
5.6	Completed pulling pipeline.
1.1	Attach beach end adaptor and dead man.
31.5	Total Active Installation Time.

Equipment. Table 5-7 lists the equipment used during installation of the pipeline. The original objective had been to install 5000 ft of pipeline. The installing unit had approximately 4650 ft of pipeline on hand, but only 3450 ft were required to reach the MLMS anchor points.

TABLE 5-7 - EQUIPMENT USED TO TRANSPORT AND INSTALL THE SIX-INCH BOTTOM-LAY PIPELINE

Bulldozer (D7)		2	
Dump Truck		1	
Wrecker with Crane		1	
10,000 lb RT Forklift		1	
Pipe Tongs		1	
Air Compressor (700 cfm)		1	
6-In. Pipe (with Cribbing and Pipe Rollers)	90-Ft Sections	- 45	4050 Ft
	60-Ft Section	- 1	60 Ft
	30-Ft Pieces	- 18	540 Ft
		TOTAL	4650 Ft
Pipe Trailers		3	
Cube Barge with 20-Ton Winch		1	
LCM-8		2	

Only 200 ft of riser hose was attached at the end of the pipeline. This is considered insufficient for larger tankers and requires that the tanker mooring be placed very accurately. A longer riser hose is recommended.

The equipment was described as being over 20-yr old and one of a kind. When subjected to a pressure test however, the pipeline performed well.

The Cube Barge used to pull the pipeline did not display an anchored vessel signal, and its anchor wire location was not marked. During installation several small craft ran over both the pipeline and the barge's anchor wire.

The pipe tongs were set into the sand above the high tide mark. The installation personnel were ordered to leave them in place along with the rollers for the retrieval, and during the following weeks high storm tides buried the tongs and rollers twice.

Procedures. The Cube Barge deployed its anchor at the MLMS and was pushed to the beach by an LCM-8 while unreeling its anchor wire. Once at the beach it attached its forward winch wire to the end of the riser hose (2-wire rope cables run the length of the riser hose and tie into the end of the pipeline). The barge then proceeded to pull itself from the beach with its anchor wire while pulling the pipeline with it. It halted every 90 ft for the crew on the beach to add another 90-ft section of pipe.

Pipe sections were added by using the pipe tongs to screw the 90-ft sections onto the pipeline. The location of the MLMS anchorage was not directly offshore of the beach site and the current pushed the barge out of alignment. The resulting sideways pull forced a 90-ft section of pipe off of the pipe track. A bulldozer was used to retrack the pipe, and then two bulldozers were used to guide the pipeline directly away from the pipe tongs before it curved to the barge (Figure 5-15). This is necessary to keep the ends of the pipe aligned so the pipe tongs can screw them together.

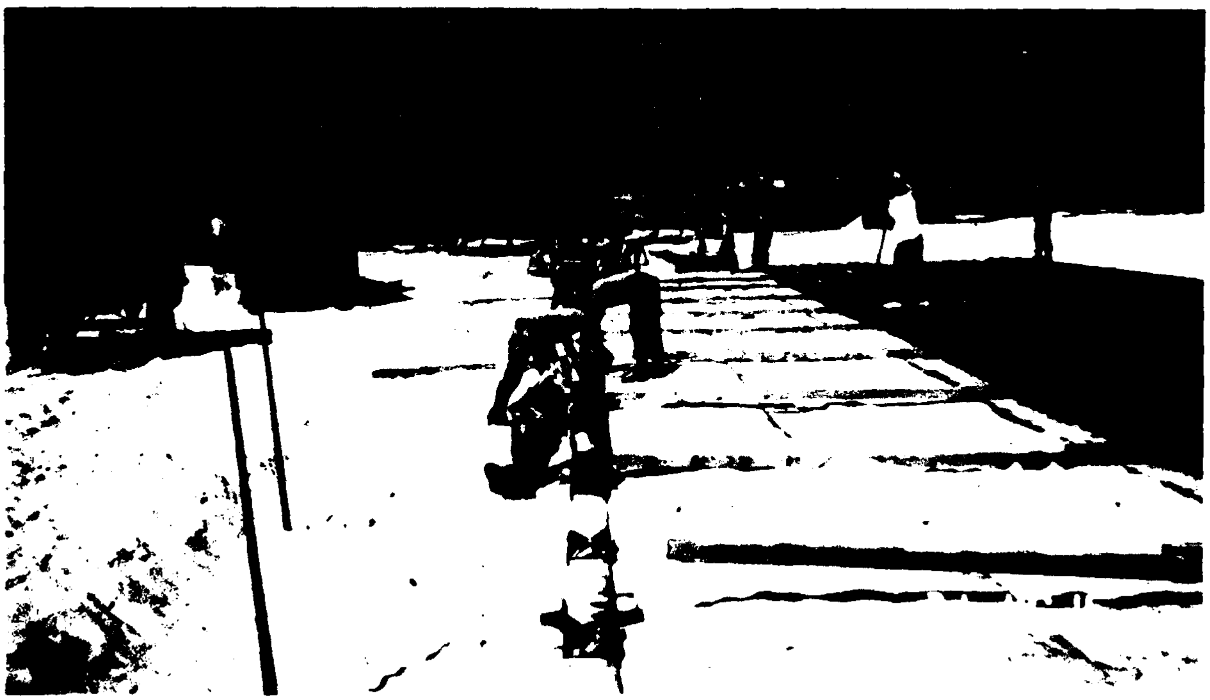


Figure 5-15 - Assembly of Pipeline

(Note Bulldozers Used to Keep Pipe Aligned with Rollers and Pipe Tongs)

A pressure test of the installed pipeline was not conducted until directed by the Joint Test Director (JTD). The test was then done at 80 psi versus the recommended 50 psi. This is considered dangerous due to the risk of damaging the riser hose by air caused delamination and the safety hazard of high air pressure.

Environment. Wave conditions during the installations of the pipeline were mild (Sea State 1) and did not affect the operation. The tidal current was up to 1.8 knots and did affect the direction of pull of the barge. The solution to the problem of an angular pull on the pipe was discussed above.

5.1.3.2.3 Drag Embedment Anchors

General. The original plan to install 4 drag anchors to provide an anchorage for the tanker at the floating hose was changed due to problems experienced with the MLMS (discussed below). Two of the drag anchors were used as stern anchors in conjunction with the tanker's bow anchors to provide a spread moor at the floating hose. The other two drag anchors were installed at the MLMS site.

Time. Anchor installation took place on 3 and 4 October. The placement required about 1 hr for each anchor. The time to place an anchor is affected largely by how much difficulty is experienced in positioning the Cube Barge carrying the anchors. The anchors must also be pulled to set them, and this required approximately 30 min per anchor once the required tug was available.

Manpower. The installation crew on the barge consisted of personnel from the 497th Engineer Company and the tugs were provided by the 11th Transportation Battalion. Personnel from the 549th Quartermaster (QM) Company were involved in the decision of where to place the anchors.

Equipment. The 6,000-lb drag anchors were equipped with a 10,000-lb concrete block with associated chain and buoy. They were carried by and deployed from a Cube Barge. Two 100-ft tugs were also used.

Procedure. The four anchors, concrete blocks, chain, and buoys were assembled and laid out on a cube barge while at Fort Eustis. The barge was towed to the test site by two 100-ft tugs which then assisted installing the anchors.

The first two anchors were installed at the floating h... 3 October. One tug towed the barge into position and th...

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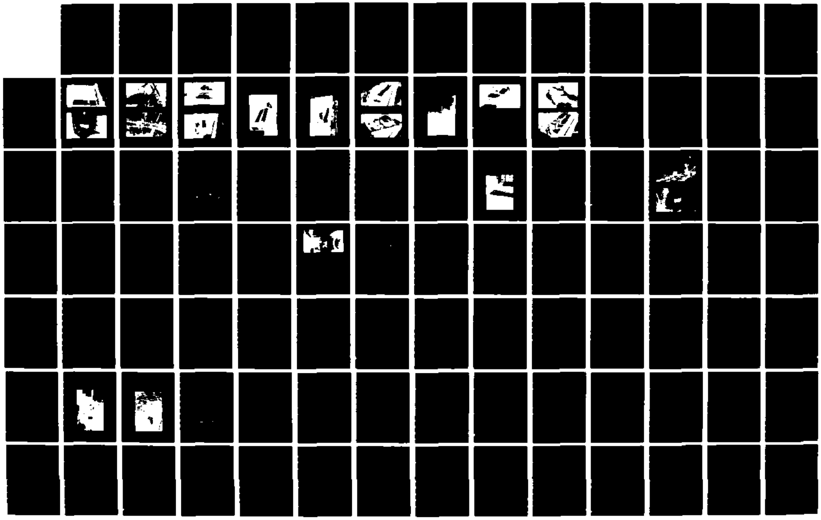

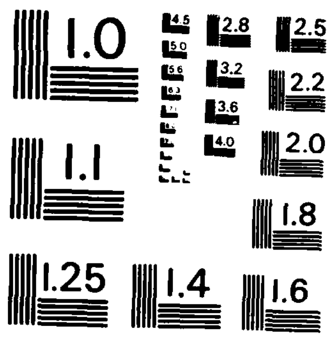

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assisted with the positioning and then pulled the anchor assemblies from the barge. The tugs and barge then departed without setting the anchors.

On 4 October, the tugs and Cube Barge returned and placed the remaining two anchor assemblies at the MLMS site. Again they departed without setting the anchors. A 100-ft tug which had been assisting the ROWPU barge was finally directed to pull the anchors to set them. This was completed about four hours after the second two had been placed.

Communication and task assignment was poor throughout the installation. The 497th thought that the tanker would set the anchors while mooring, but the tanker's captain refused to attempt to moor until the anchors had been set.

When the tanker attempted to moor at the MLMS site it discovered that one of the drag anchors was about 500 ft out of place. On 5 October, a TCDF was brought out from Little Creek to move the anchor. However, while setting it, the anchor chain broke. Weather and other operational considerations prevented the replacement of this anchor and the MLMS site was never used.

Environment. Several operations were delayed due to poor weather. These are listed in Table 5-8. Generally, conditions greater than Sea State 2 prohibit or greatly restrict deploying the barge with the anchors and installing anchors from the barge.

Summary. Installing and setting drag anchors can be done in about 1-1/2 hr per anchor in Sea State 0-2. The anchors should be set immediately and then checked by divers before the installation equipment leaves the area.

A new system for positioning should be utilized to enable accurate placement with respect to the beach and each other. The radar system used by the MLMS (page 5-36) is recommended.

Moving and retrieving the anchors requires a TCDF. This severely limits the ability of the anchors to be moved or redeployed quickly, and leaves an open question regarding future availability of the TCDF.

5.1.3.2.4 TMT Onshore Storage and Delivery System

General. A single module of the TMT onshore system was installed at the beach and tied in with various fuel storage and transfer equipment to

TABLE 5-8 - Drag Anchor Installation Delays

Date	Condition	Description of Delay
Oct 1	Sea State 3	Prevented craft from leaving Little Creek and starting installation
Oct 3	20+ Kt SE Wind and Current Going East	Prevented tanker from mooring to drag anchors located to west of hoseline (see 5.2.3.2.3)
Oct 6	Sea State 3	Prevented craft from leaving Little Creek to replace damaged anchor.

facilitate pumping the water across Fort Story and storing it. Two BFTA's were included for storage. The BFTA is discussed in Section 5.1.3.2.5.

Time. The basic TMT onshore module was installed on 21 September in a total of 3 hr and 12 min by utilizing very good team work and simultaneous tasks. The personnel were highly trained and an Army evaluator estimated that an ordinary team would take two to three times as long.

Installation of the cross base pump stations and intermediate storage tanks required 11 hr on 1 October.

Manpower. Installation of the basic TMT onshore module was done by a platoon from the 549th QM Company consisting of a total of 49 personnel. The platoon was split into four sections as follows: Section 1, twelve; Section 2, fourteen; Section 3, twelve; Section 4, ten; and one officer in charge.

Installation of the cross base pump stations and intermediate storage tanks was performed by an unspecified number of personnel from the 549th and 109th QM Companies.

Equipment. The basic TMT onshore module consisted of the following equipment:

8	-	50,000 gal Bags
1	-	350 gpm Pump
2	-	600 gpm Pumps
15	-	Distribution Points
2	-	Filter/Separator Units
Miscellaneous	-	Hoses and Valves

The equipment used to install the TMT onshore module consisted of two 5-ton trucks and one 10,000-lb forklift.

The cross base pumping and intermediate storage consisted of the following equipment in addition to an unspecified amount of existing pipelines and 50,000 gal bags.

2	-	BFTA's (Refer to Section 5.1.3.2.5)
12	-	50,000 gal Bags
2	-	42,000 gal Bolted Steel Tanks
6	-	600 gpm Pumps

Procedures. The basic TMT onshore module was installed by a very organized team which was split into 4 sections (see above for personnel numbers). The work was divided among the sections as follows:

Section 1	-	Set up 15-distribution points with 2-filter/separators.
Section 2	-	Hook up suction discharge hoses and valves with four 50,000 gal bags.
Section 3	-	Same as Section 2.
Section 4	-	Install interface section and discharge hoses, valves, one 350 gpm pump and two 600 gpm pumps.

The platoon was very organized and set up the system so that there was easy access to everything which contributed greatly to the quick installation. During installation however, many valves and hoses were dragged in the sand without dust covers which would have resulted in considerable contamination of fuel when the system was put into operation. Also, the hoseline was not protected at trail and road crossings and was frequently driven over.

Environment. The only environmental effect on the installation of the TMT onshore module was the contamination of the equipment by the sand. Additional care should be taken to use the dust covers available.

Sand berms were not constructed around the bags to minimize disturbance of the environment. Berms are not necessary for operation of the storage bags but would normally be constructed to minimize spill damage.

Conclusions. Installation of the TMT onshore system went extremely well.

- One module of the TMT onshore system required 3 hr 12 min to install.
- Installation of an entire onshore system should be demonstrated to determine the effect of the increased complexity.
- Personnel should be instructed to avoid getting sand in the system.
- Care should be taken to protect the hoses at trail and road crossings.

5.1.3.2.5 Bulk Fuel Tank Assembly (BFTA)

General. Two 50,000 gal BFTA's were installed a total of four times as part of their Follow-On Evaluation (FOE) which was conducted by the Engineer Test Division of the U.S. Army Armor and Engineer Board (USAARENBD). This FOE is discussed in detail in Reference 10.

Time and Manpower. BFTA installation was performed four times from 11-13 September 1984. Table 5-9 presents the deployment times, personnel and conditions.

Equipment. The handling capacity, including bulk and cube, of the 5-ton wrecker, and/or 10,000-lb rough terrain forklift is not exceeded by the BFTA when crated or uncrated. A 10,000-lb forklift was utilized for lifting, loading, unloading crate and bladder. A 5-ton wrecker was utilized for lifting a BFTA out of crate and lifting for storage in ISO container. A 5-ton cargo truck was used to store and transport crated BFTA's.

Conclusions relating to BFTA equipment include the following:

- The BFTA crate at 21-ft 4-in. long will not fit inside a 20-ft ISO container.
- The lid of the BFTA crate is too long and heavy for troops to properly handle.

TABLE 5-9 - BFTA INSTALLATION CONDITIONS AND RESULTS

Date	11 Sept	12 Sept	12 Sept	13 Sept
Trial No.	1	2	3	4
BFTA	No. 1	No. 2	No. 2	No. 1
NBC Protective Clothing	No	Yes	Yes	No
Weather	Cloudy	Overcast	Overcast	Overcast
Site Conditions	Dry	Dry	Dry	Dry
Light Conditions	Daylight	Daylight	Darkness	Darkness
Site Slope (Percent)	2	<1	<1	2

TIME (minutes)

Site Prep*	18	15	5	12
Uncrate*	10	19	9	5
Emplace	2	2	1	1
Unroll/Unfold	9	14	8	7
Prepare for Operation	18	15	8	5
TOTAL TIME**	47	50	26	25

*These events can be and were performed concurrently.
**Total times are rounded to the nearest whole minute. Shorter deployment times on trials three and four are attributed to increased personnel experience from trials one and two.

- The BFTA cannot be properly installed due to the lack of line leveling equipment and height safety poles.
- The technical manuals provided were incomplete.

Procedures. The deployment of the BFTA was conducted in the following steps:

1. Clear site - Site is cleared of sharp objects and leveled.
2. Transport - Vehicle transporting BFTA arrives on site. Transportation was simulated after first trial because crate was repacked and left on site.
3. Unload/Uncrate - Crate lid and accessories are removed from crate.
4. Emplacement - Bladder is removed from crate and lowered to the geometric center of site
5. Unrolled/Unfold - Bladder is laid out for attachment of accessories.
6. Preparation - All accessories are connected to bladder.

Difficulties were encountered during steps 1, 2, and 3 due to the equipment shortcomings discussed above.

5.1.3.3 Multi-Leg Mooring System (MLMS) Anchorage

General. Four MLMS anchors were to be used in conjunction with the tankers bow anchors to create a 6-point spread moor at the site of the bottom laid pipeline. Installation of the MLMS anchors was completed and Mooring-Leg Deployment Devices (MLDD) were left attached as mooring buoys. During subsequent pull tests however, two of the anchors pulled out (a fifth anchor was installed after the first one pulled out). Also, during the time prior to the tanker being available, 2 MLDD's were separated from their anchors by unknown causes. The tanker mooring was cancelled and the anchors recovered.

Time. Installation of the MLMS anchors took place from 12 to 20 September, 1984. Many delays were incurred due to weather and equipment and personnel nonavailability. Table 5-10 provides a listing of the installation times.

Installation of the anchors required approximately 8 hr each to prepare on the beach, tow to the site and fire. The installation is considered a daylight operation so a 4-anchor mooring would require 4 day shifts to install.

TABLE 5-10 - MLMS ANCHOR INSTALLATION TIMES

Start Time	End Time	Event
12 Sep 0800	1545	Prepare anchor on beach, tow to site, fire anchor, and attach MLDD as buoy.
13 Sep 0800	1530	Same as above with second anchor.
14 Sep 0800	1630	Same as above with third anchor.
15 Sep 0900	1630	Same as above with fourth anchor.
16 Sep		No operations due to Sea State 3 conditions.
17 Sep		No operations due to Sea State 3 conditions.
18 Sep 0900	1100	Pulled and set first anchor. Second anchor pulled out while attempting to set it.
20 Sep 0800	1600	Install 5th anchor (replace 2nd anchor)
3 Oct 0900	1700	Pulled and set one anchor, pulled another anchor out while attempting to set it. MLMS installation terminated.

Manpower. Personnel from the Belvoir R&D Center (BRADC), the Naval Ordnance Station, and a civilian contractor provided direction and expertise. Support was provided by 5 personnel from the 549th QM Company and the crews of a LARC-LX and LARC-V.

Equipment. Table 5-11 lists the equipment used to install the MLMS anchors. The MLMS anchor flukes were designed for firm sand and clay and not the mud conditions existing at Fort Story. This is considered the reason that they failed the pull tests.

TABLE 5-11 - EQUIPMENT USED TO INSTALL THE MLMS ANCHORS

MLMS M-50 Anchors	5
MLDD	5
Motor Surf Boat	1
Surf Boat Sled	1
LARC-LX	1
LARC-V	1

The MLDD's used as mooring buoys were stripped of all equipment since they were to be employed for several weeks and the equipment (winch and anchor housing) would have suffered corrosion by the salt water. A Coast Guard approved battery-operated light was attached to each MLDD for night visibility.

A LARC-LX was used to pull the first 4 MLDD's and motor surf boat (skid mounted) from the beach into the water where the surf boat took over and deployed the MLDD's. A LARC-V was used to deploy the fifth anchor/MLDD instead of the motor surf boat.

Procedures. A MLDD with winch and anchor housing was towed to the anchor site by the surf boat. Personnel on the MLDD then lowered and fired the anchor. The line from the anchor was then transferred to a second MLDD which had been stripped of equipment. This required personnel to be transferred between the boat and the MLDD's which limits the operation to relatively calm water (Sea State 1-2).

Positioning of the anchors was done using a Del Norde radar unit on the deployment boat which correlates its position with two transmitters on the beach. The boat matches its position with pre-selected coordinates which results in accurate placement prior to firing.

Environment. Wave conditions above Sea State 2 prevented normal installation since the motor surf boat could not operate, and personnel transfer

to the MLDD became hazardous. Wind and current have relatively little effect on the anchor firing, but do make it more difficult for the boat to hold the MLDD in position prior to firing.

Summary. A calm water capability to install the MLMS was demonstrated. However, when trying to set the anchors, two were pulled out. The anchor's failure was attributed to the design of the fluke which was not suitable for soft bottoms.

Two MLDD's were separated from their anchors prior to mooring the tanker. Standard mooring buoys with lights are recommended versus using stripped down MLDD's as long term buoys.

5.2 CARGO THROUGHPUT

Data was collected on the Army's capability to move containers, breakbulk cargo, and bulk liquid from the sea to the shore. Lighters were assigned to specific cargo operations with crossing transit lanes. The cargo throughput phase allowed the Army the opportunity to demonstrate:

- the capability to accomplish throughput with existing inventory and evolving cargo handling hardware;
- the interactions of concurrent cargo operations; the capability of accomplishing a desired throughput rate.

5.2.1 Container Operations

Operations involved both offloading and backloading of containers between the EXPORT LEADER and Army lighters. Offloading and backloading was accomplished with the T-ACS between 1 and 10 October. The Army TCDF conducted offloading operations between 15 and 17 October. Army lighterage used throughout these operations included the LACV-30, LCU 1466, LCU 1600, and LARC-LX.

Beach transfer systems included the DeLong Pier and Elevated Causeway (ELCAS) for LCU's, and the Amphibian Discharge Site for LACV-30's and LARC-LX's. Army yard tractors and 40-ft trailers were used to transport containers to the Marshalling Yard where they were unloaded by RTCH's.

5.2.1.1 Operations at T-ACS

Table 5-12 shows a summary of container movement for each shift during the Army portion of the Throughput Test. Where no container offload is recorded, or a minimal 11 containers in the case of 6 October, there were either test-delaying weather conditions or backloading evolutions. By excluding these shifts and those attributed to the TCDF, the Army offloaded a total of 936 containers with the T-ACS in eight shifts. Table 5-13 shows the total container movement by lighter for the shifts of each of the three segments of Army offloading.

TABLE 5-12 - CONTAINER MOVEMENT DURING THE ARMY TEST

Date	Offload			Backload		
	Dayshift	Night Shift	Total	Dayshift	Night Shift	Total
1 Oct	-	-	-	32	-	32
2 Oct	-	-	-	21	55	76
3 Oct	-	-	-	104	91	195
4 Oct	91	132	223	-	-	-
5 Oct	125	84	209	-	-	-
6 Oct	11	-	11	-	-	-
7 Oct	105	-	105	-	151	151
8 Oct	-	-	-	157	132	289
9 Oct	187	117	304	-	-	-
10 Oct	95	-	95	-	-	-
11 Oct	-	-	-	-	-	-
12 Oct	-	-	-	-	-	-
13 Oct	-	-	-	-	-	-
14 Oct	-	-	-	-	-	-
15 Oct	-	3	3	-	-	-
16 Oct	27	27	54	-	-	-
17 Oct	18	-	18	-	-	-
TOTAL			1022			743

Note: T-ACS Operations 1 October - 10 October
TCDF Operations 15-17 October

TABLE 5-13 - CONTAINER OFFLOAD SUMMARY OF ARMY OPERATIONS USING T-ACS

Date	Shift	Containers Offloaded	LACV-30		LCU 1466		LCU 1600		LARC-LX		LCM-8	
			Dep	Cont	Dep	Cont	Dep	Cont	Dep	Cont	Dep	Cont
4 Oct	Day	91	16	32	3	18	9	39	1	2	-	-
	Night	132	21	41	5	25	15	60	3	6	-	-
	TOTAL	223	37	73	8	43	24	99	4	8	-	-
5 Oct	Day	125	19	38	6	36	11	50	1	1	-	-
	Night	84	14	27	4	27	5	19	3	10	1	1
	TOTAL	209	33	65	10	63	16	69	4	11	1	1
6 Oct	Day	11	1	2	1	2	1	2	3	5	-	-
	Night	-	-	-	-	-	-	-	-	-	-	-
	TOTAL	11	1	2	1	2	1	2	3	5	-	-
7 Oct	Day	105	-	-	-	-	-	-	48	105	-	-
	Night	-	-	-	-	-	-	-	-	-	-	-
	TOTAL	105	-	-	-	-	-	-	48	105	-	-
CYCLE	Day	332	36	72	10	56	21	91	53	113	-	-
	Night	216	35	68	9	52	20	79	6	16	1	1
	TOTAL	548	71	140	19	108	41	170	59	129	1	1
9 Oct	Day	187	94	187	-	-	-	-	-	-	-	-
	Night	117	26	52	6	35	7	30	-	-	-	-
	TOTAL	304	120	239	6	35	7	30	-	-	-	-
10 Oct	Day	95	10	20	3	17	7	34	12	24	-	-
	Night	-	-	-	-	-	-	-	-	-	-	-
	TOTAL	95	10	20	3	17	7	34	12	24	-	-
CYCLE	Day	282	104	207	3	17	7	34	12	24	-	-
	Night	117	26	52	6	35	7	30	-	-	-	-
	TOTAL	399	130	259	9	52	14	64	12	24	-	-
15 Oct	Day	-	-	-	-	-	-	-	-	-	-	-
	Night	3	2	3	-	-	-	-	-	-	-	-
	TOTAL	3	2	3	-	-	-	-	-	-	-	-
16 Oct	Day	27	8	15	-	-	4	12	-	-	-	-
	Night	27	16	27	-	-	-	-	-	-	-	-
	TOTAL	54	24	42	-	-	4	12	-	-	-	-
17 Oct	Day	18	12	18	-	-	-	-	-	-	-	-
	Night	-	-	-	-	-	-	-	-	-	-	-
	TOTAL	18	12	18	-	-	-	-	-	-	-	-
CYCLE	Day	45	20	33	-	-	4	12	-	-	-	-
	Night	30	18	30	-	-	-	-	-	-	-	-
	TOTAL	75	38	63	-	-	4	12	-	-	-	-

Note: Dep = Departures
Cont = Containers

5.2.1.1.1 Lighter Approach and Moor

Adverse weather and local tidal currents caused difficulties in mooring lighters to the T-ACS. Moorings were always easier when performed on the lee side. Additional factors that complicated mooring operations include:

- confusion on the part of the lighter coxswain regarding the precise mooring location at a given station;
- the curvature of the T-ACS hull at Station 2; and,
- the LCU 1600 requirement to moor with its deckhouse outboard.

The fact that there was difficulty in mooring is not an adverse reflection on the individual craft master, but indicates a need for more training under these conditions. There appeared to be no standardized mooring procedures for lighters. One should be developed and used by all lighters of a type.

Table 5-14 shows a summary of the lighterage approach and moor times for the period the Army offloaded the EXPORT LEADER via the T-ACS.

TABLE 5-14 - T-ACS/ARMY LIGHTERAGE APPROACH AND MOOR TIMES

Lighter	Approach and Moor Test Data Summary	
	Average Time (min)	Sample Size
LCU (mix)	7.9	72
1600	8.7	49
1466	6.5	23
LARC-LX	4.6	61
LACV-30	4.3	187

Data analysis revealed the following conclusions with respect to mooring times:

- Mooring in daylight was about 1-min faster than at night for LACV-30's and LARC-LX's. However, there were only six data points for night LARC operations as opposed to 54 for daytime. Mooring of LCU's was an average of 2-min faster at night.
- There was no distinguishable difference in mooring times between any of the T-ACS mooring stations for a given lighter.
- As the test progressed there was a 1-min improvement with time for the LACV-30, 2 min for the LARC, and no improvement or degradation for the LCU.
- The LACV-30 and the LARC were much faster than the LCU.

5.2.1.1.2 Crane Cycles and Lighter Loading

During the Army portion of the test, four-point slings were used in lieu of spreader bars for lifting containers. The slings had the advantage of not requiring exact alignment prior to connecting to a container. Unlike spreader bars, slings require the stevedores to have access to the top of the container to engage the corner castings. The addition of spacer plates and sling color coding enhanced the stevedores' abilities to attach the proper individual sling to its respective corner casting (Figures 5-16, 5-17, and 5-18). Forty-foot spreader bars were used to offload five 40-ft containers. Due to their extra size and weight, these spreader bars were more difficult than their 20-ft counterparts to align with containers. This operation is shown on the various Army lighters in Figures 5-19, 5-20, 5-21, and 5-22. Forty-foot spreader bars were also required for moving hatch covers on the EXPORT LEADER.

Normal container loadout for the Army consisted of two 20-ft containers on LARC's and LACV'30's, four to five on the LCU 1600 class, and six to seven on the LCU 1466 class. These are illustrated on Figures 5-23, 5-24, 5-25, and 5-26.

Container handling operations were slowed by the need for boat jumpers and the requirement for critical spotting and lashing on the LACV-30. There were a few occasions where containers damaged the LACV-30 deck. The LACV-30 life raft is in an exposed location when the craft is used for

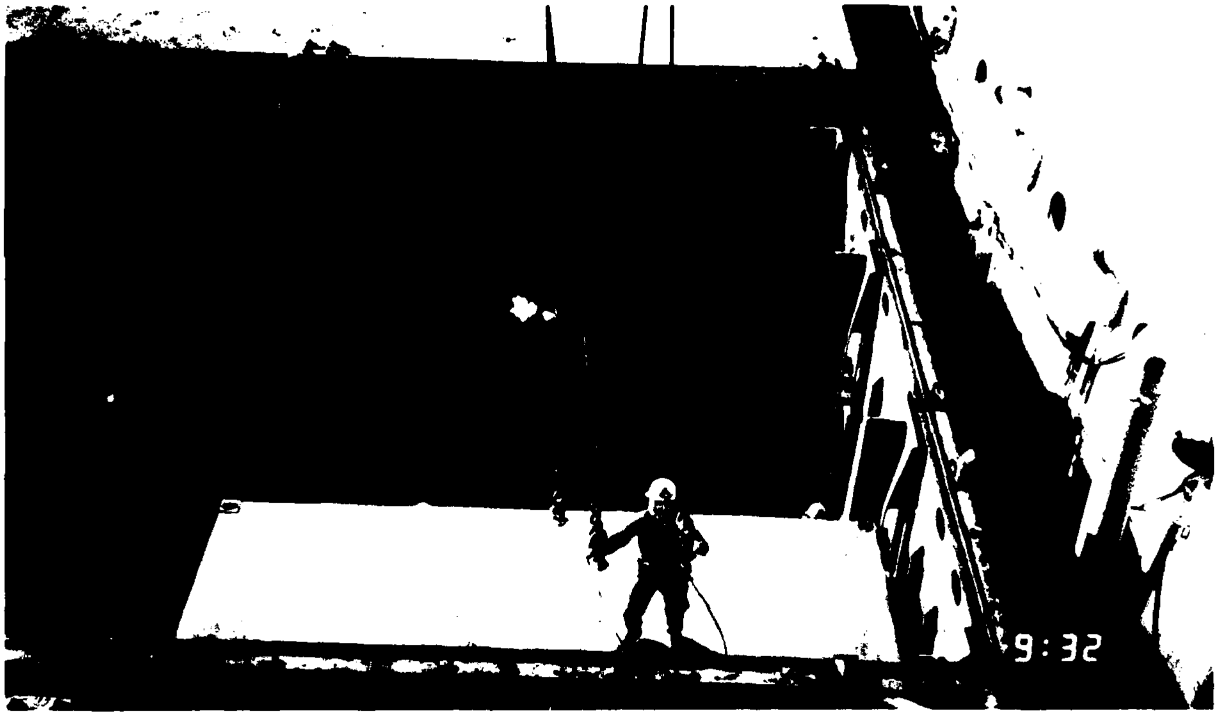


Figure 5-16 - Attaching Color-Coded Slings to Container

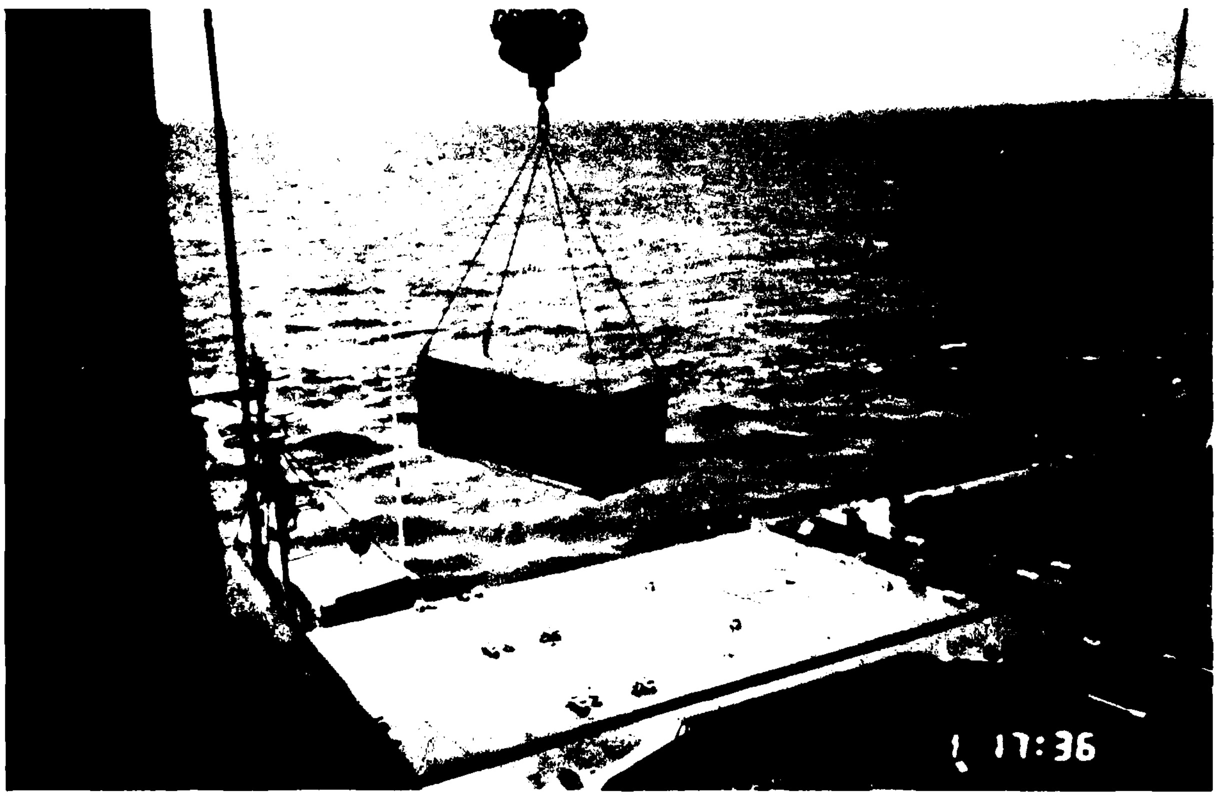
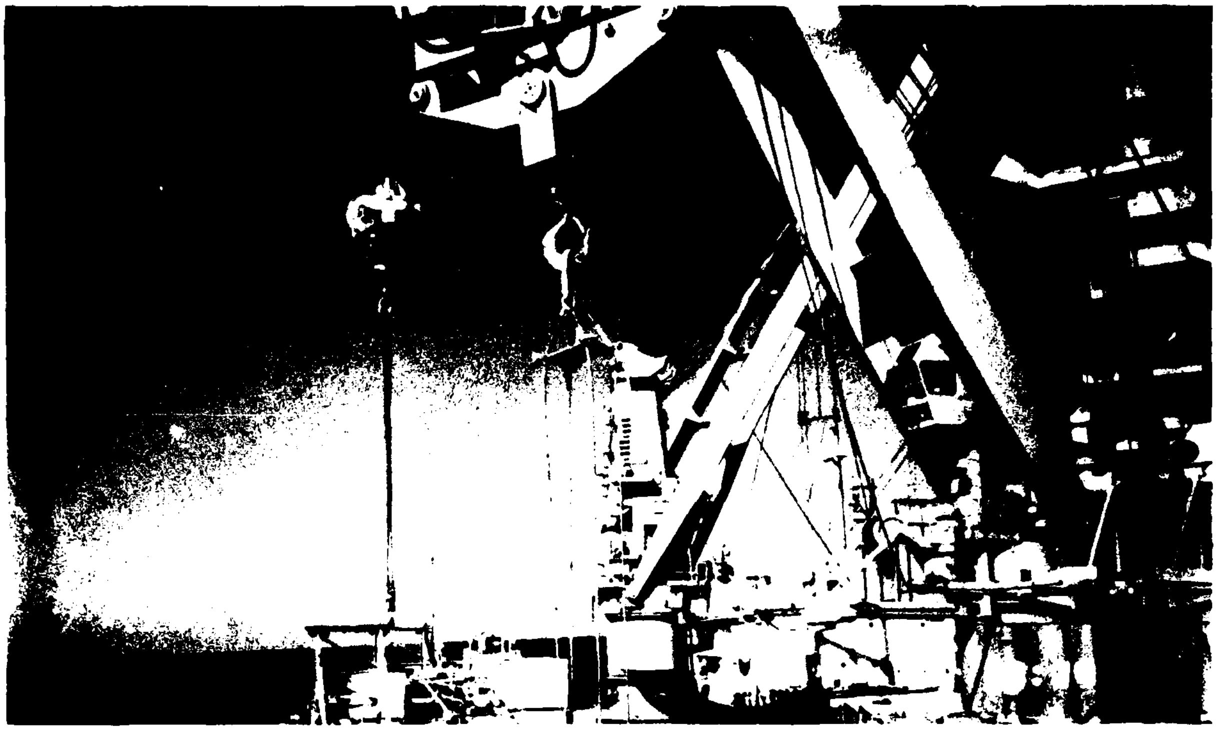


Figure 5-17 - Slings Used to Move Containers



(a)

(b)

Figure 5-18 - Two Types of Sling Spreader Plates

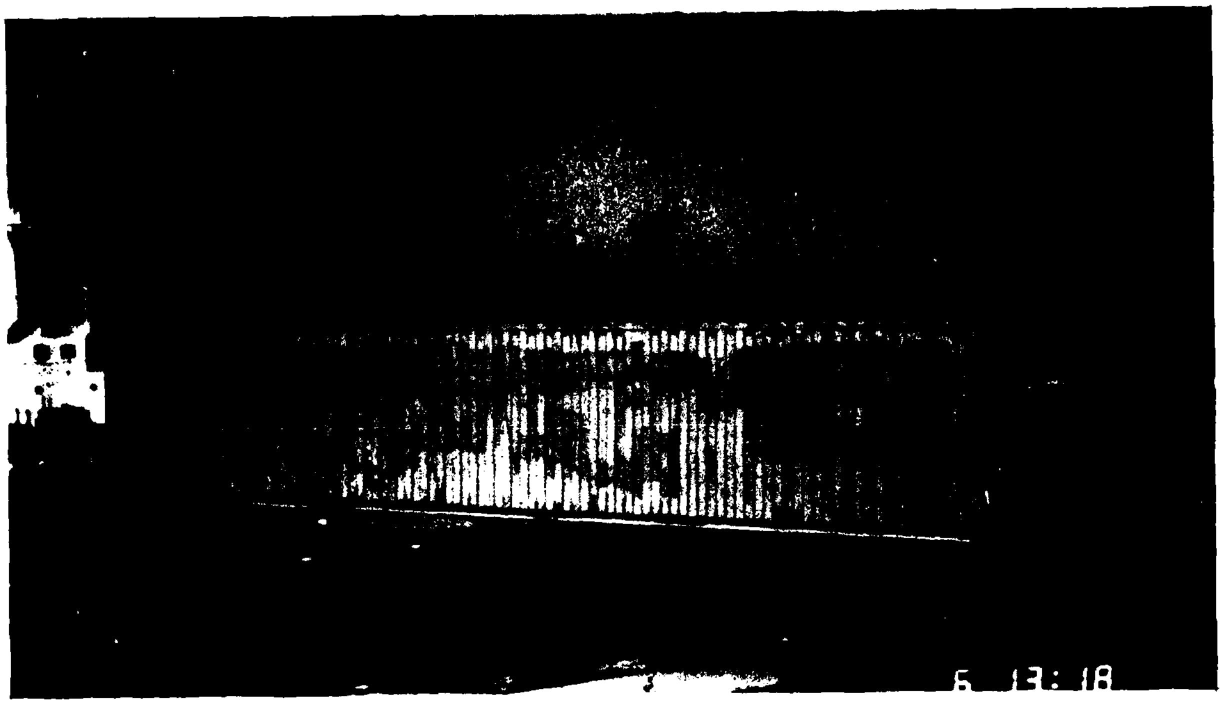


Figure 5-19 - 40-Foot Container Handling

Figure 5-20 - 40-Foot Container on LARC-LX

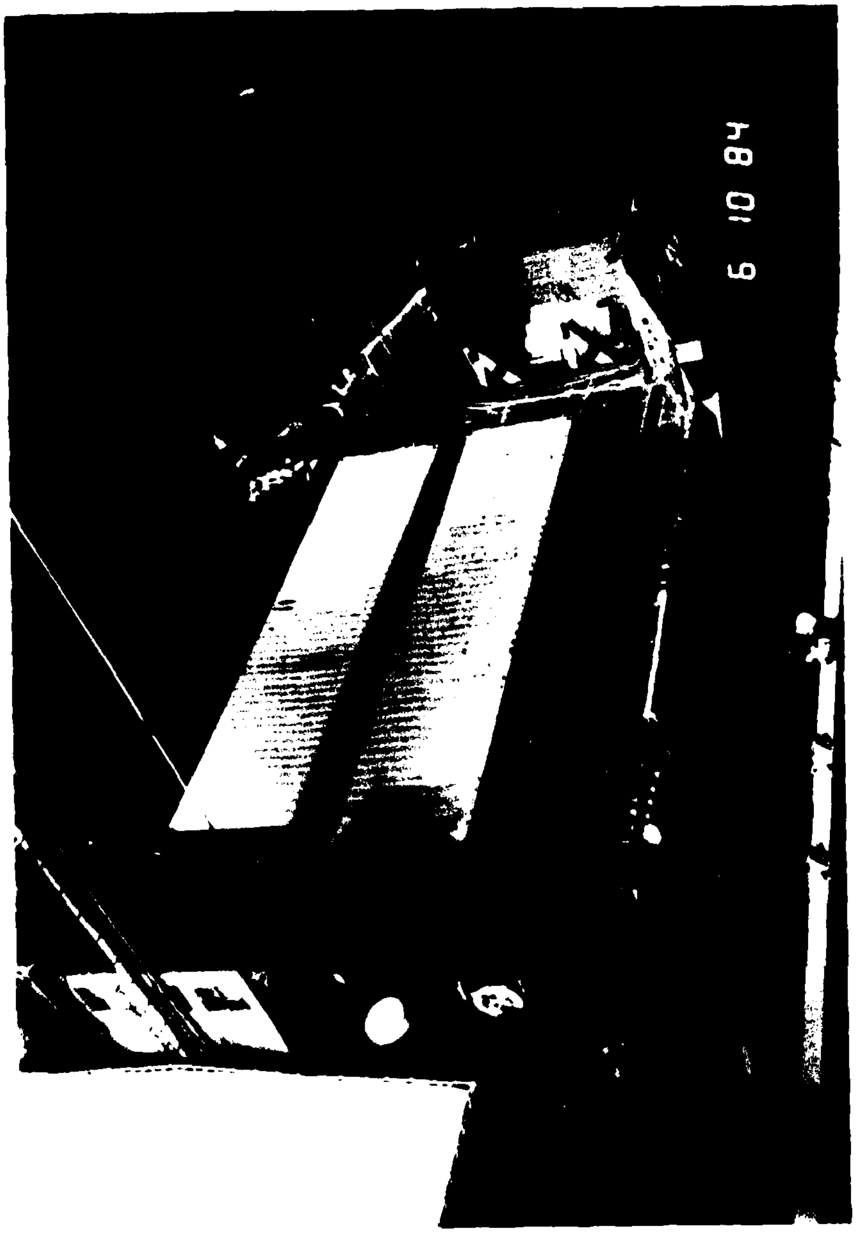


Figure 5-21 - 40-Foot Containers on LCU-1466 Class

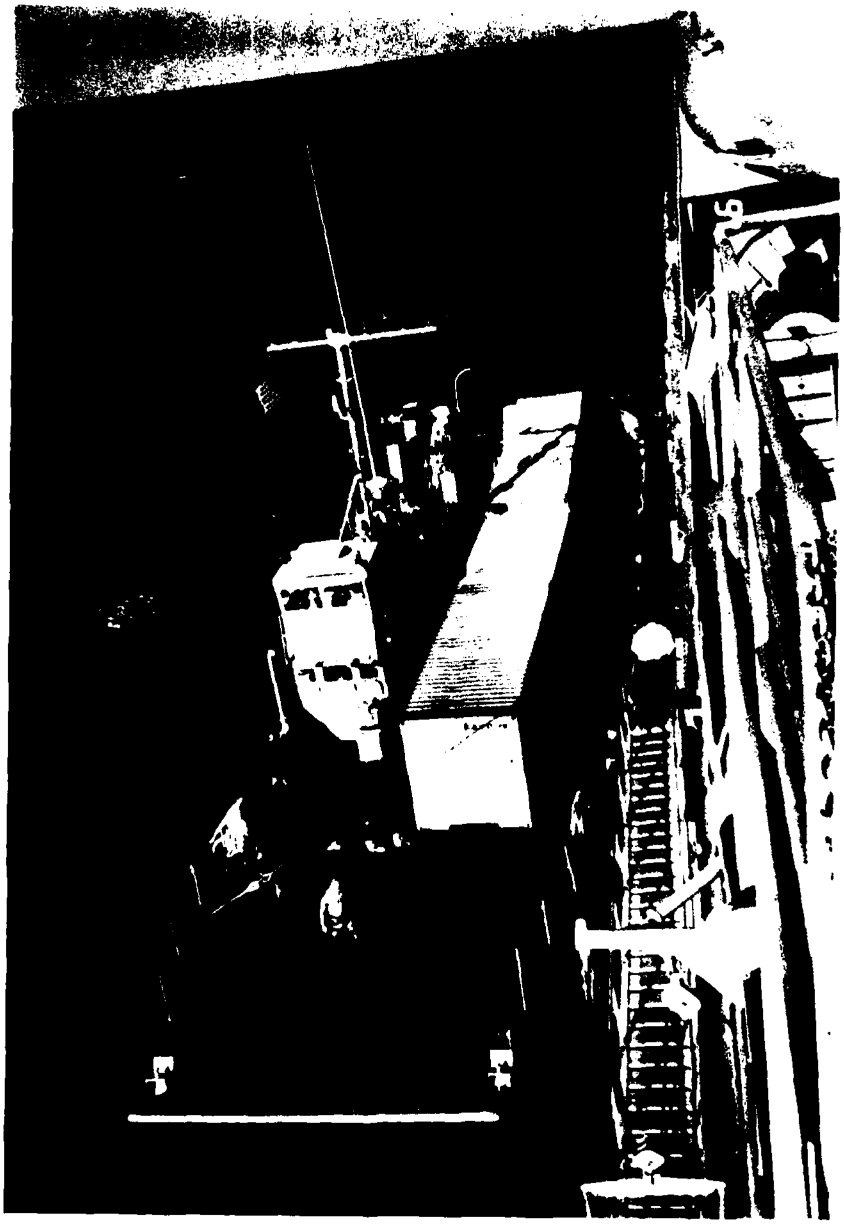


Figure 5-22 - 40-Foot Containers on LCU-1600 Class

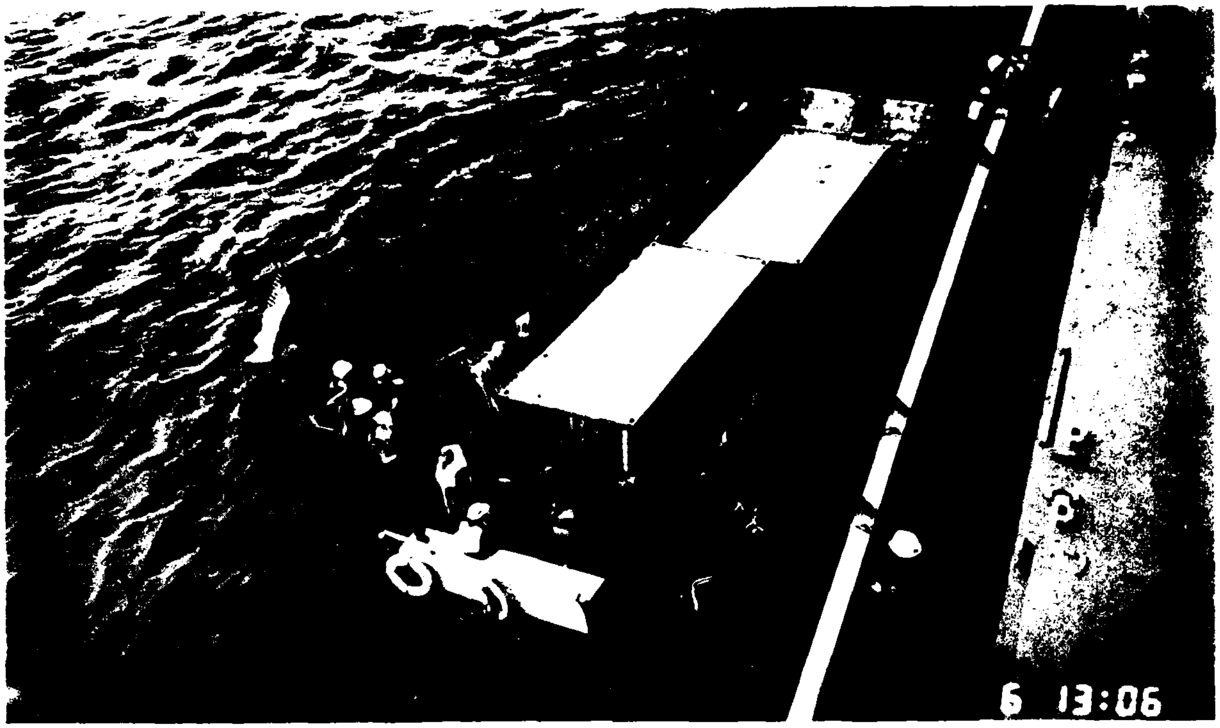


Figure 5-23 - Typical LARC-LX Container Loadout

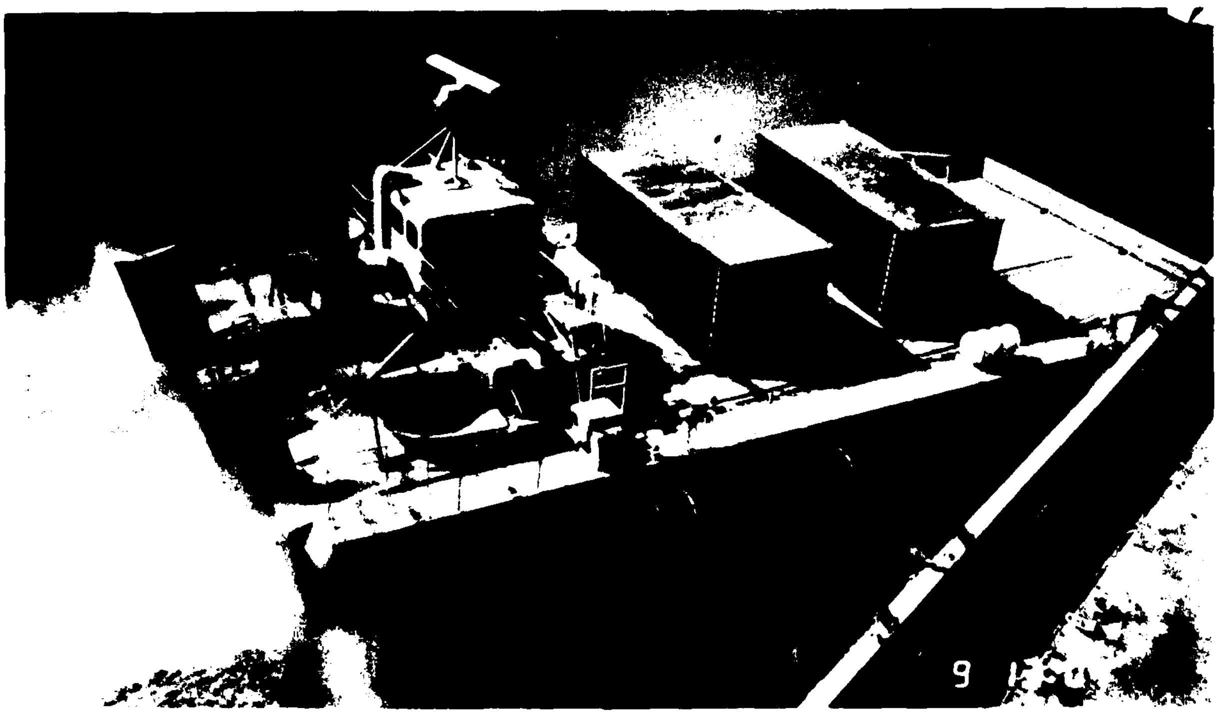


Figure 5-24 - Typical LACV-30 Container Loadout

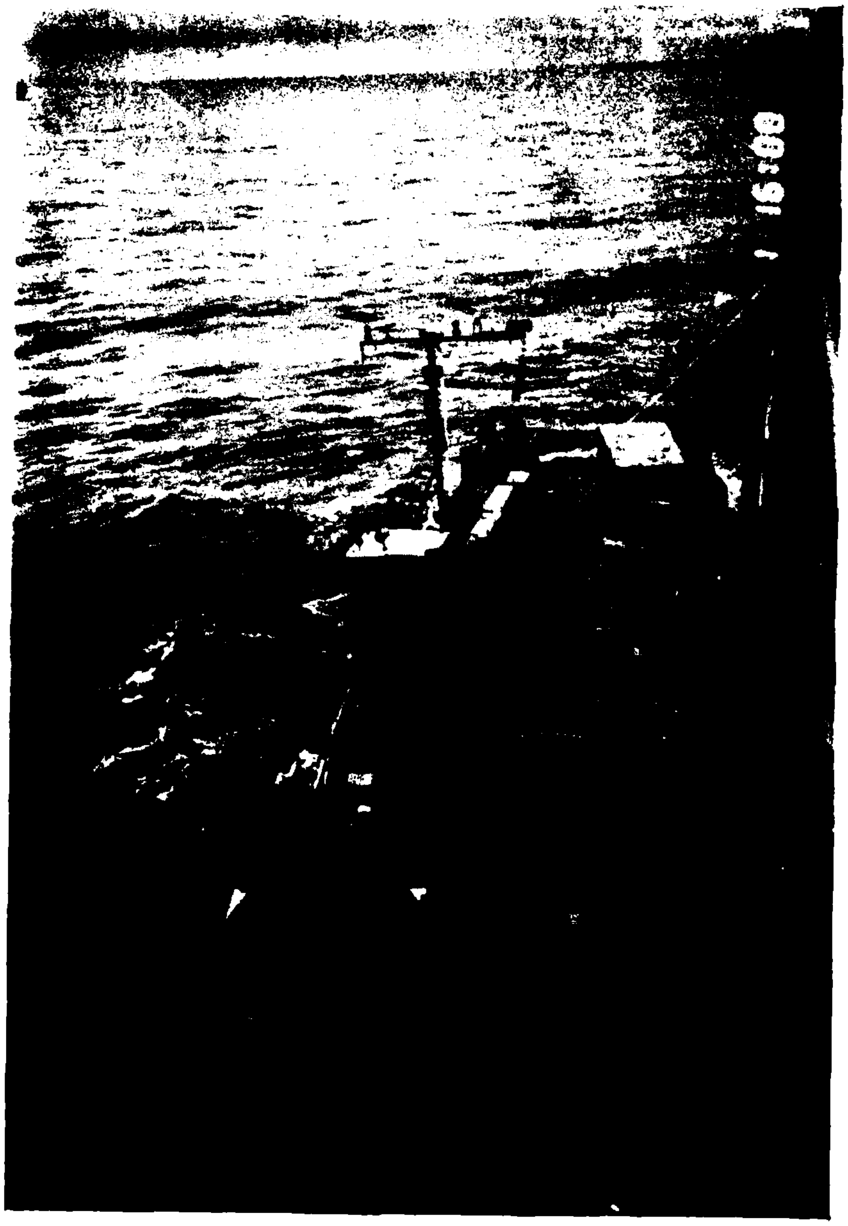


Figure 5-25 - Typical LCU-1600 Container Loadout

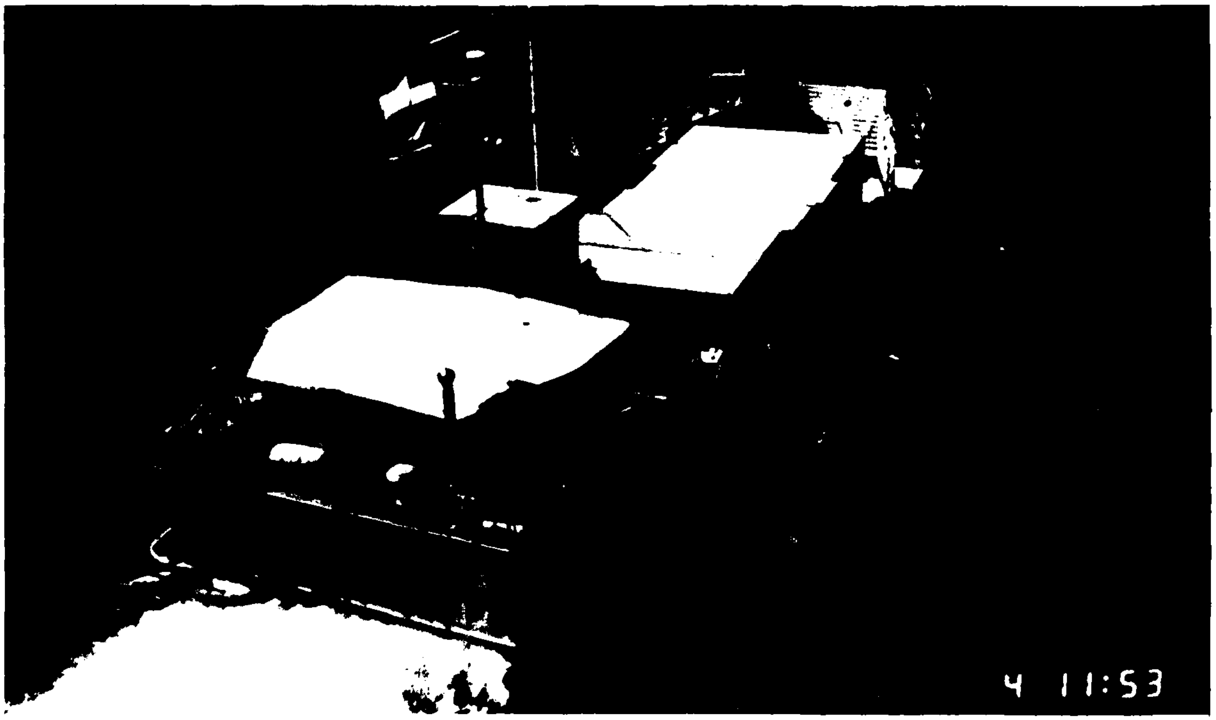


Figure 5-26 - Typical LCU-1466 Container Loadout

container operations (see Figure 5-24). Coast Guard requirements for life rafts not withstanding, consideration could be given to either removing the life raft and using individual life preservers or relocating the life raft well clear of the cargo area.

The stacking of containers on LCU's and LARC's was performed a limited number of times. Figures 5-27 and 5-28 show the stacking on a LARC and LCU 1466. Although this did not present an adverse impact on container handling times, stacking is considered unsafe because:

- no container lashing was used;
- stability of the lighter and the stack is unknown;
- container handlers onboard the LARC have very limited operating room atop the craft's wingwalls; and
- the field of vision of the LARC coxswain is severely reduced.

In actual operation, container weight will average more than the average container weight of the JLOTS test, resulting in the possibility of exceeding the lighter load limits if stacking is employed.

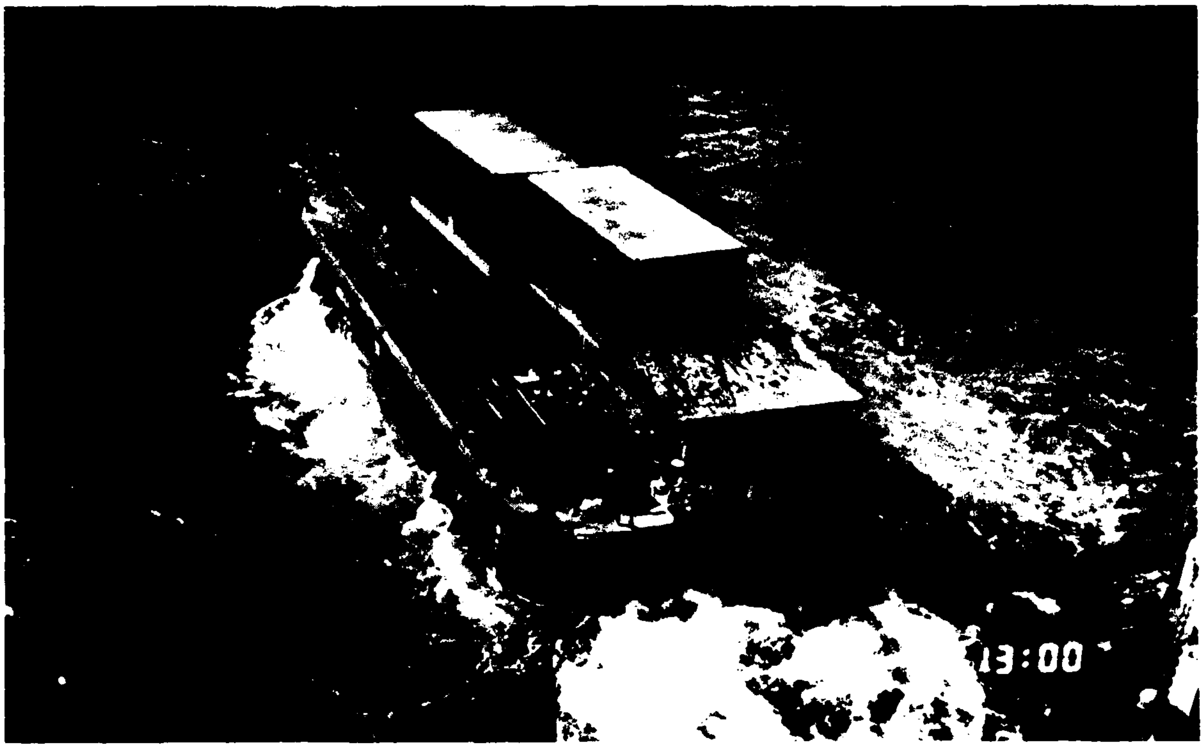


Figure 5-27 - Container Stacking on LARC-LX

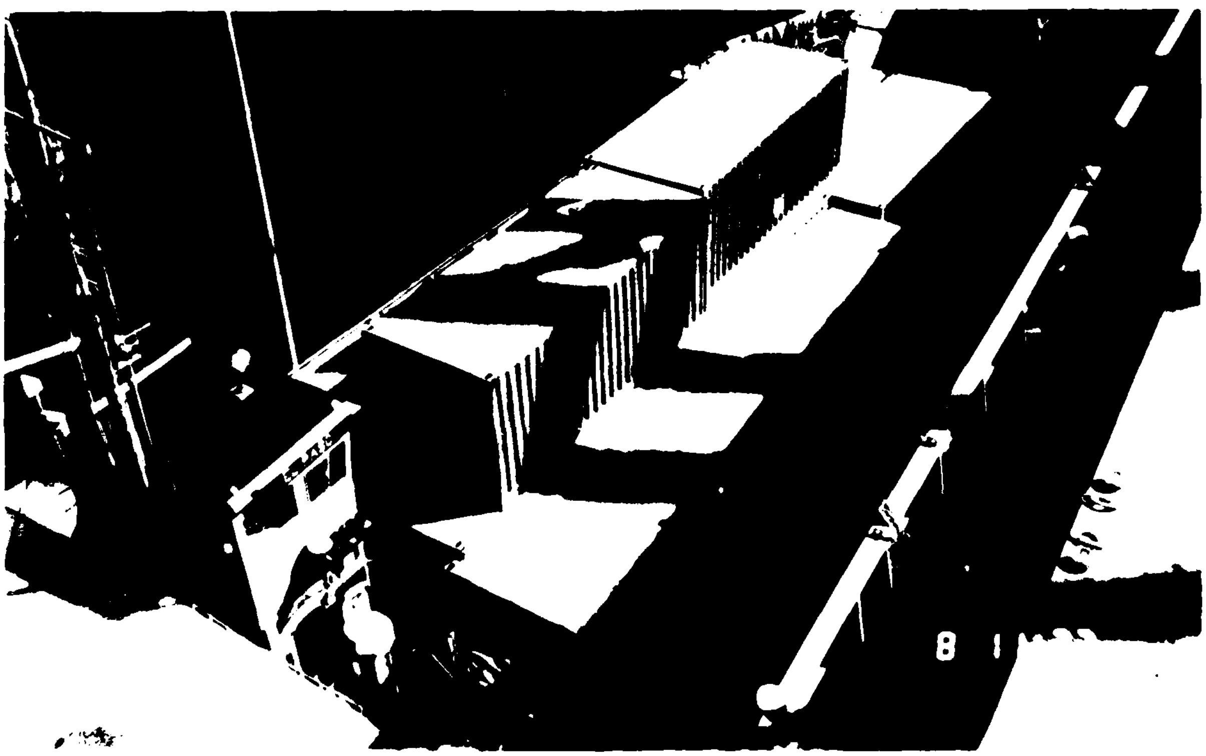


Figure 5-28 - Container Stacking on LCU-1466

The number of containers loaded on a particular lighter type varied. The range of load size (for 20-ft containers), and the average container load per lighter type is given in Table 5-15. It is important to note that the LACV-30 average load of 2.0 containers was possible because there were only twenty-eight 20-ft containers in the test that exceeded 11.5 short tons. Only four of these were ever moved ashore by LACV-30.

TABLE 5-15 - AVERAGE CONTAINER LOAD PER ARMY LIGHTER

Lighter Type	Range of Containers Carried	Average Container Load
1466 LCU	2-8	5.7
1600 LCU	3-5	4.3
LARC-LX	2-4	2.1
LACV-30	1-2	2.0

An analysis of the data was performed to compare the T-ACS crane cycle times. Table 5-16 shows the crane cycle times for offloading containers from above and below the weather deck of the EXPORT LEADER for the various conditions during the Army phase. The contents of this table were obtained from the available data where more than one crane was loading a lighter, (except for crane 3A) and two or more containers were loaded by a single crane. Cycle time was defined as the time from the container on the deck of the lighter to the next container on the deck.

The number of cycles for crane 1A offloading containers from above deck is considered insufficient but has been included for record. The overall average crane cycle for offloading containers stored above deck on the EXPORT LEADER is 9.5 min; 11.6 min for containers stored in the holds. The average crane cycle for offloading containers stored above and below is 11.0 min. This 11.0 min is considered a conservative expected performance value due to inaccuracies in data acquisition and variations in other types of anticipated container ships. It is worth noting that there is no

TABLE 5-16 - T-ACS CRANE CYCLE TIMES

Crane/ Container Location	1 A		1 B		2 A		2 B		3 A	
	Above	Below	Above	Below	Above	Below	Above	Below	Above	Below
Total Time (min)	30	961		1094	222	267	311	213	418	253
Total No. of Cycles	2	81		90	24	26	36	21	41	23
Average Total Time (min)	15.0	11.9		12.2	9.2	10.3	8.6	10.1	10.2	11.0
Avg Time per Crane (min)	11.9		12.2		9.8		9.2		10.5	

distinguishing difference in crane cycle times between single and double tier loading of containers in lighters. There is also no noticeable improvement in crane cycle times as the Army phase progressed.

The crane cycle time during the Army phase was faster than the 16.0 min expected performance value for the Navy Causeway Ferries. This is because the Army predominately used slings for container operations. The Navy data reflected a higher usage of manual spreader bars which were more difficult to align, especially in the holds of the containership. The data of Table 5-16 does not include crane delays that are typically incorporated into the Navy data. Since a causeway was alongside the ship for hours, any crane delays affected the overall crane cycle times. During the Army phase, lighters with a much lower cargo-carrying capacity were used. These lighters had many more mooring cycles than the Navy causeways. If a crane was delayed, a lighter moored at another available station.

A limited amount of data was available for a crane operating alone, without interference from the other crane on the pedestal. The lighter loadout times for this condition were compared to another condition where a lighter was loaded by a single crane boom, but the adjacent crane(s) loaded a different lighter(s). As shown in Table 5-17 the average container load time is comparable. The agreement suggests that all the data for single boom loadout of lighters is suitable for comparing loadout times between the various lighters.

TABLE 5-17 - SINGLE CRANE LOADING TIME COMPARISON

Lighter	Date	Crane	Lighter Load Time	No. of Cont	Avg. Cont Load Time (min/cont)
LCU-1586	10/10	1A*	59	6	9.8
LCU-1678	10/4-5	3A*	38	4	9.5
LCU-1678	10/5-6	1A*	41	4	10.25
LCU	All	Single** Boom	348	37	9.4

*Adjacent crane not working
**Adjacent crane working different lighters

Table 5-18 shows a comparison of the container loading rates for one crane or two cranes for the various Army lighters. The total load time of all the samples is the sum of the individual times from mooring completion to the time the last container was put onto the lighter deck and disconnected from the crane.

Two cranes were commonly used to load both LACV-30's and LCU's. Since the two crane T-ACS loading rates in Table 5-18 reflect the average combined rate of container placement on the lighter, each crane has an effective cycle time twice the container loading rate. Therefore, the individual crane boom cycle time estimated performance figure for future planning should be 8.4 and 11.5 min/boom for LACV-30 and LCU respectively.

TABLE 5-18 - LIGHTER LOADING TIMES

Lighter	Total Load Time (min)	Total No. of Loads	Total No. of Cont Loaded	Crane Boom Load Rate (min/boom)	T-ACS Load rate (min/cont)	No. of Cranes Used
LACV-30	955 990	65 118	132 236	7.2 8.4	7.2 4.2	1 2
LCU	348 1817	8 67	37 316	9.4 11.5	9.4 5.8	1 2
LARC	412 188	33 22	66 44	6.2 8.5	6.2 4.3	1 2

5.2.1.1.3 Lighter Cast-Off and Clear

The cast-off started when the last container was on the deck of the lighter and disconnected from the crane. The lighter was clear of the T-ACS when it was about 100 yd away. The loaded lighters generally were able to cast-off and clear the T-ACS mooring stations without difficulty. Other than the relative positioning of lighters awaiting their turn to approach and moor, the only aspect of cast-off and clear that requires attention is the spray and noise from a departing LACV-30 on another lighter moored at an adjacent station.

Table 5-19 is a test data summary of the actual cast-off and departure from T-ACS during the Army portion of the test.

Analysis of the data developed the following conclusions:

- Cast-off and clear times did not change between day and night operations using LCU's and LARC's. Cast-off and clear took LACV-30's about 1.5 min longer at night than during the day.
- There was no noticeable difference in cast-off and clear times between the three T-ACS mooring stations.
- There was no improvement in the cast-off and clear times for the LACV-30 as the test progressed. There was about a 1-min and 2-min improvement for the LCU and LARC, respectively.
- The LACV-30 and the LARC were faster than the LCU.

TABLE 5-19 - T-ACS/ARMY LIGHTERAGE CAST-OFF AND CLEAR TIMES

Lighter	Cast-Off and Clear Test Data Summary	
	Average Time (min)	Sample Size
LCU (mix) 1600 1466	4.8 4.8 4.9	74 52 23
LARC-LX	3.8	68
LACV-30	4.0	189

5.2.1.1.4 Summary Comments

The rate of lighter loadout is influenced more by lighter operations than by crane cycle times. This can be understood by noting the time consumed by the lighter to get into position prior to loading, and clear after loading. Table 5-20, which summarizes data from Tables 5-14 and 5-19, shows the average times for various Army lighters. Figure 5-29 shows total time of 17 min is needed for two cranes to load a total of two containers on a LARC at a given mooring station. The average container cycle time, as mentioned earlier, is 8.5 min. Figure 5-29 also illustrates that it is more efficient to load two LARC's at each station using one crane for each LARC. For example, if a single LARC at each of Stations 2 and 4 is to be loaded by two cranes it will take 34 min for the T-ACS to offload 8 containers. If two LARC's were moored at each of Stations 2 and 4, and each of the four cranes were used to load two containers onto a given LARC, it would take 20.9 min for the T-ACS ship to offload 8 containers. During the test it was not uncommon to find three LARC's consuming the total space of Stations 2 and 4. However, there is no guarantee that doubling lighters at stations would be employed in the future. Consequently, the expected performance recommended for LARC's is the more conservative 8.5 min per boom specified in Table 5-18.

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TABLE 5-20 - SUMMARY OF LIGHTER MANEUVERING AT T-ACS

Lighter	Approach and Mooring			Cast-Off and Clear		
	Average Time (min)	Range of Times (min)	Sample Size	Average Time (min)	Range of Times (min)	Sample Size
LCU (Mix)	7.9	1-30	72	4.8	1-27	74
1600	8.7	1-30	49	4.8	1-27	51
1466	6.5	4-13	23	4.9	1-14	23
LARC-LX	4.6	1-13	61	3.8	1-22	68
LACV-30	4.3	1-24	187	4.0	1-16	189

```
      M1         L1         D1         M2         L2
|----------|----------|----------|----------|---   ---->

     4.5        8.5        4.0
|<-------->|<-------->|<-------->|      Legend:
                                        M = Lighter Moor Time
            17.0 minutes                L = Lighter Load Time
|<<------------------------------>>|    D = Lighter Departure Time
                                        C = Crane Cycle Time
```

(a) Using Two Cranes

```
      M1               L1               D1         M2
|----------|--------------------|----------|---   ---->

     4.5        6.2        6.2        4.0
|<-------->|<-------->|<-------->|<-------->|

                 20.9 minutes
|<<--------------------------------------->>|
```

(b) Using One Crane

Figure 5-29 - Time Line for Loading Two Containers onto a LARC-LX

Table 5-21 shows container handling improvement for the various lighters throughout the Army phase of the test. The averages were determined from the time the first container was over the lighter to the time the lighter loadout was complete, divided by the number of containers in the load. Improvement with time was noticeable for LACV-30's and LARC's. In a number of cases, data on the first container placed in the lighter was invalid and was discarded. When this was done, the time for loading the remaining containers was used, with the divisor adjusted accordingly.

TABLE 5-21 - AVERAGE CONTAINER HANDLING TIMES (MINUTES/CONTAINER)

Lighter	DATE/SHIFT								
	10/4D	10/4N	10/5D	10/5N	10/6D	10/7D	10/9D	10/9N	10/10D
LACV-30	18.1	6.5	3.8	4.1	*	-	3.1	3.5	3.3
LCU	5.2	4.6	6.0	6.8	4.5	-	-	5.7	6.2
LARC	*	7.7	*	6.4	5.0	5.6	-	-	2.8

* Insufficient Data

Figure 5-30 shows the container movement for backload and offload along with the prevailing sea state. Looking at the offload shifts of Figure 5-30 and eliminating those days where high sea state influenced the operations, a comparison can be made between single and mixed lighter operations. The day shift of 7 October (Sea State 2) is not eliminated since the LARC-LX, which operated exclusively during that shift, performed equally well in Sea State 1 and 2. The first offloading shift was eliminated because of learning curve steepness. Records indicate that LCC communications problems were substantially improved starting with the night

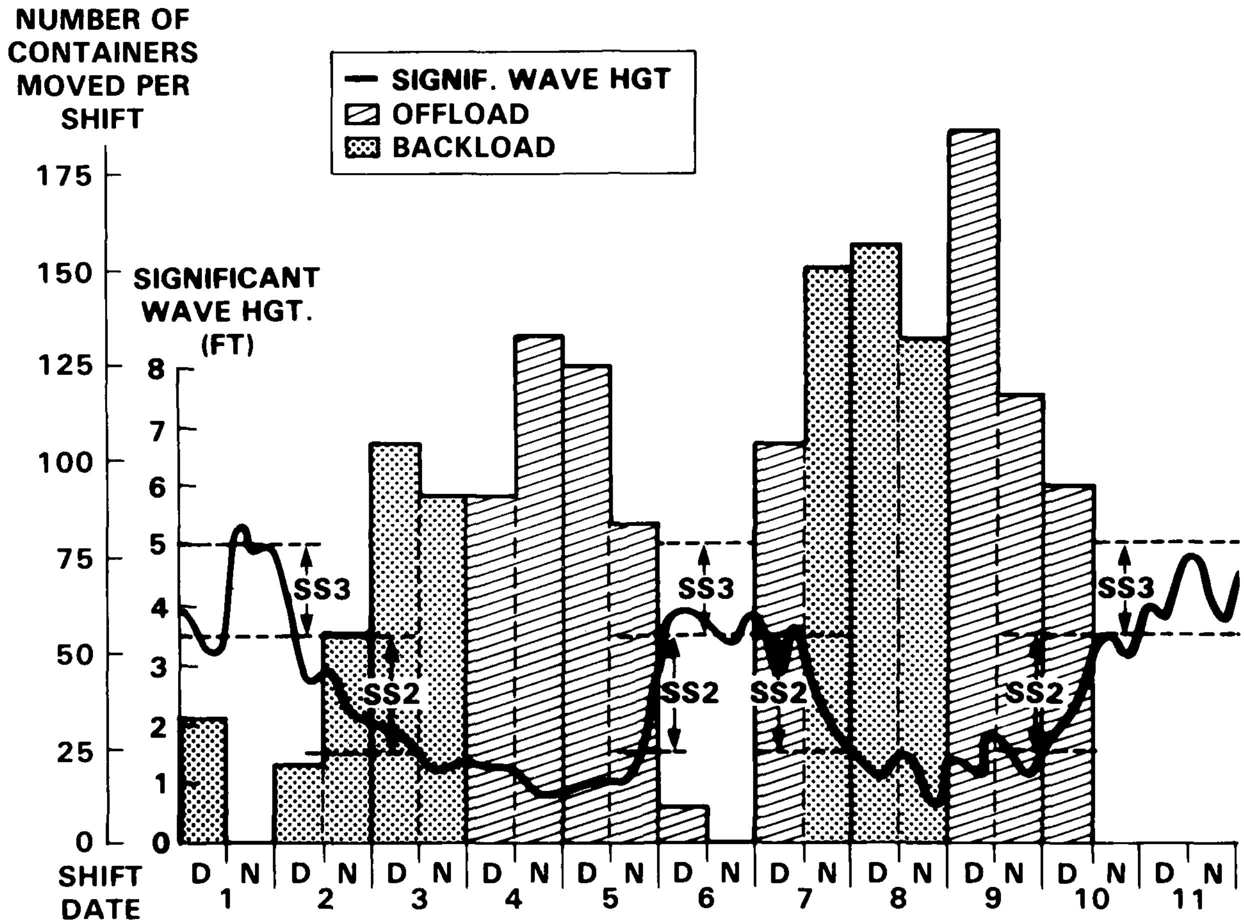

Figure 5-30 - Army/T-ACS Operations - October 1984

shift of 4 October. It can be seen from the summary in Table 5-22 that LACV-30's operating alone clearly moved the largest number of containers in one shift. This is primarily attributed to overall command emphasis that was exerted on this shift. Mixed lighters were more productive than LARC's used alone. The data therefore does not support a general consensus prevalent during the test that the use of a single type of lighter is more productive than mixed lighters.

TABLE 5-22 - PRODUCTIVITY OF SINGLE VS MIXED LIGHTER OPERATIONS

Date	Type of Lighter	No. of Containers Offloaded
10/4 N	mixed	132
10/5 D	mixed	125
10/7 D	LARC	105
10/9 D	LACV-30	187
10/9 N	mixed	117

It can be stated, based on operational decisions, that the LARC is the most reliable lighter for Sea State 2 operations. It can also be stated that single lighter operations run more smoothly than mixed due to the reduction of interferences inherent to different lighters such as the special noise, spray, and fendering characteristics of the LACV-30. Communications and overall LCC operations are also simplified during single lighter operations.

The container throughput day shift was also analysed to compare day and night operations. There were three basic offloading thrusts during the Army portion of the test. The first offloading cycle took place in the period between 4-7 October. Operations on 4 and 5 October were conducted during Sea State 1 conditions. Data from 4 and 5 October only were examined because all other data were known to include effects that would

override any day/night effects. The result is that an equal number of 216 containers were offloaded in the two day shifts and the two night shifts in the period 4-5 October. Thus, the average of 108 containers moved is the same for either day or night shift.

It can be concluded that an acceptable state of readiness can be obtained only if more frequent training tests are conducted. There were intraservice procedural problems that were exposed in this environment which must be corrected and documented into training manuals. Such problems involve:

- the lack of a macroscopic familiarization by individual units of the operational objectives;
- inadequate communication nets and radio operator etiquette;
- the lack of established chains of command to preclude interference from "unauthorized" individuals and/or various pockets of centralized autonomous control that do not have common objectives; and,
- inadequate training and anticipation of potential problem areas.

VIP visits were given top priority, and various aspects of the test were staged at the expense of establishing throughput.

Delays were often attributable to the ship motions resulting from prevailing ground swells which caused the T-ACS to roll. These delays only occurred during tidal changes as the ships swung about the anchor and were exposed to swells on their beams. Once the ships had shifted, operations would usually restart. The single bow anchoring configuration resulted in the mooring stations being to windward on a portion of each tidal cycle. The preferred arrangement is with the lighter mooring stations to lee. Delays due to lack of lighters alongside the ship can be attributed to communications or lighter maintenance problems.

The H-fender used presented problems. These fenders had sustained significant damage throughout the test. Chain links were broken when lighters got caught on the fenders and the wood facings were worn and splintered. The H-fenders were raised to avoid damage to LACV-30 skirts, then they became an interference concern to the propeller blades due to the craft's pitching. Once these fenders were raised the station was dedicated to the LACV-30 use since it would not be practical to lower them each time a different type lighter came alongside.

Interface problems were apparent between the military stevedores and the T-ACS civilian crane operators. There are three basic reasons for the problems.

- The T-ACS civilian positions did not attract or retain fully qualified individuals. Individuals could use the crane operator training to obtain better positions when available in the maritime industry.

- A lack of continuity developed because the civilian crane operators and military stevedores did not report to the same superiors. Civilian crane operators are also regulated by prevailing union rules.

- There was a lack of sufficient planning and training to ensure a standard means of communications between Army stevedores and civilian crane operators. Army stevedores were required to use hand signals to communicate with the crane operators. The crane operators were unable to understand the hand signals being used by the Army stevedores and had to provide an impromptu training session. Later, hand-held radios were used by the stevedores to communicate with the crane operator.

Various safety hazards existed throughout the test:

- LCU crew members, without hard hats or safety shoes, were helping to position containers on board lighters.

- LACV-30 spray, noise, and air blast were hazardous to adjacent lighters and personnel. Prior to LACV-30 operations the surrounding shipboard area should be inspected for loose debris that might become airborne from the air blast and injure someone or damage the craft's propellers. Personnel should wear safety glasses, ear protection, and straps on their hard hats.

- LACV-30 crew members were occasionally observed pushing on a swinging container being loaded while standing between a container already on the craft and the incoming container. Taglines are a better means for controlling the incoming container.

- Personnel often put themselves in confined spaces on lighters where they could be crushed by a swinging container.

- Stacking containers on a LARC requires stevedores to work on limited spaces atop wingwalls while trying to position a second tier container. A pendulating container could knock them overboard.

- Containers were held in an elevated position for extended periods rather than returned to the decks.
- Personnel walked under hoisted containers.
- Personnel sometimes put themselves in a position, while moving hatch covers, where there was no escape route if they lost control of pendulating hatch covers.
- Cargo handler sometimes guided a second tier container into position atop another container by grabbing the inside underneath corner casting. If this container dropped suddenly, he could lose a hand or fingers.
- Container removal from the holds of the EXPORT LEADER was at times done with more emphasis on working the containers vertically instead of horizontally. This is shown in Figure 5-31. This approach will ultimately have stevedores working atop a stack of containers where it is more than a one-container drop to the next lower level.

5.2.1.2 Operations at TCDF

Table 5-23 gives a summary of the TCDF operations. The times do not include all delays associated with the weather and are therefore misleading. Although the total 75 container movements are not shown in Table 5-23, those shown constitute the useable data and are representative of the TCDF test. Lighter Station 7 was outboard of TCDF (BPL 6702). The TCDF operations were slowed and stopped frequently due to the Sea State 2 conditions that prevailed throughout this portion of the Army test. Figure 5-32 shows the container movement and prevailing sea state. By comparison, the TCDF had 2 to 3 times the roll of the T-ACS.

There was no noticeable superiority between the two TCDF's. The TCDF at Station 7 had pendulation control (Figure 5-33) and the one at Station 8 had a load equalizing beam (Figure 5-34) which allowed compensation for off-center loads. While the load equalizing beam system allowed independent lifting of either side of the container, the container could not be rotated due to the two-point attachment to the crane. The problems imposed by the Sea State 2 conditions were compounded by the Army's use of manual spreader bars instead of the four-point slings. The slings were part of the T-ACS equipment and therefore left with the T-ACS ship prior to the TCDF operations.

Figure 5-31 - Vertically Unloading EXPORT LEADER

TABLE 5-23 - TCDF SUMMARY

Lighter	Station	No. of Containers	Approach and Moor Times in min (total min/ samples)	Loading Time in min (total min/ samples)	Departure Time in min (total min/ samples
LACV-30	7	30	4.8 (91/19)	10.8 (323/30)	5.6 (106/19)
LACV-30	8	27	6.4 (103/16)	11.2 (303/27)	9.7 (155/16)
TOTAL LACV-30	7 & 8	57	5.5	11.0	7.4
LCU	7	6	3.5 (7/2)	15.5 (93/6)	2.5 (5/2)
LCU	8	6	3.0 (6/2)	7.0 (42/6)	12.5 (25/2)
TOTAL LCU	7 & 8	12	3.2	11.2	7.5

Hatch cover handling took 1.5 hr. Warping the TCDF within reach of an adjacent hatch cover took 10 min.

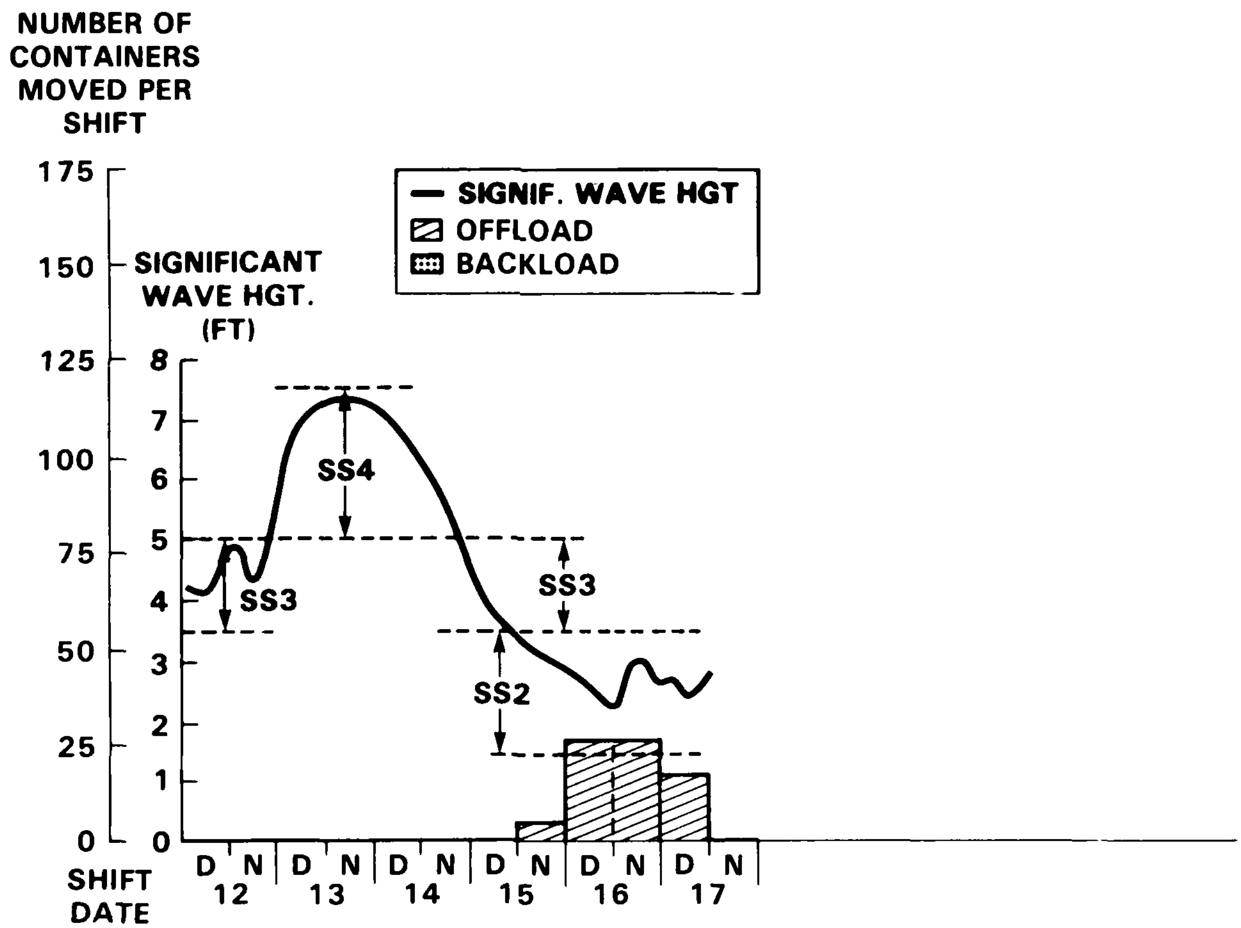

Figure 5-32 - Army/TCDF Operations - October 1984

Figure 5-33 - TCDF with Motion Compensation

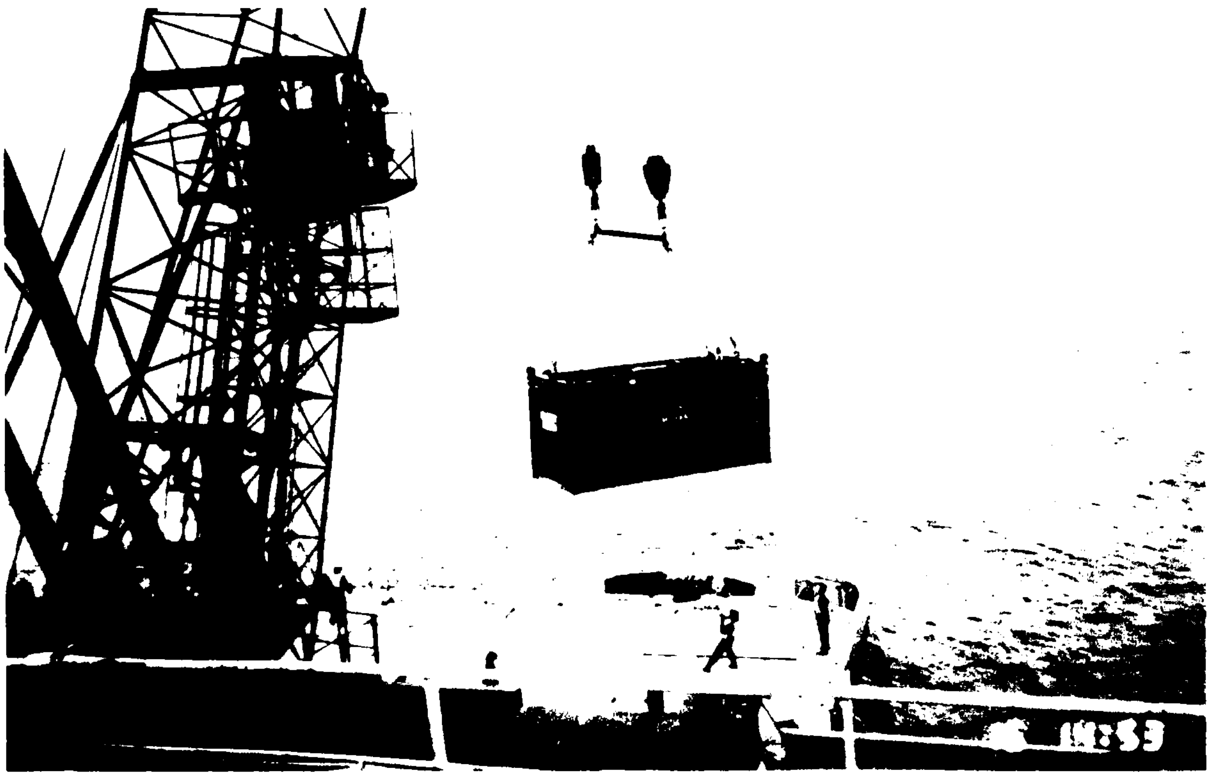

Figure 5-34 - TCDF with Load Equalizing Beam

5.2.1.3 Lighter Transit

General. Lighter operations were conducted in accordance with established procedures. Movement of lighters between the T-ACS/TCDF and the beach discharge facilities was relatively trouble free.

Time. Transit times for LCU's were measured from the time the lighter cleared the T-ACS/TCDF to the time it was within approximately 100 yd of the beach discharge facility. The approach and moor maneuver began at this point. Transit times for the LARC-LX and the LACV-30 are measured to the time the lighter arrived at the Amphibian Discharge Site on the beach. Transit times are given in Table 5-24.

TABLE 5-24 - ARMY THROUGHPUT TEST
AVERAGE TRANSIT TIMES

Lighters	Includes All Recorded Data		Excludes Extreme Data Values	
	Average Transit Time	Sample Size	Average Transit Time	Sample Size
1466 LCU	103.9	24	22.9	18
1600 LCU (D)	83.3	35	30.5	30
1600 LCU (E)	77.5	19	23.4	12
LARC-LX	16.9	60	13.2	54
LACV-30	7.9	198	7.6	195

(D) Trips to DeLong Pier
(E) Trips to ELCAS

The LCU transits were interrupted by numerous delays which resulted in distorted average transit times (left two columns). The obvious extreme values were eliminated from the data in the determination of the last two columns. Eighteen data values out of a total of 78 were considered extreme and not representative of continuous lighter operations. The excluded values varied from 1-hr 13-min to 18 hr with 7 values in excess of 4 hr. Some of the observed causes of these extreme values are:

- LCU's would depart the transit leg and leave the test area prior to completing delivery of their container load ashore. They returned after the delay, which was sometimes the following day, to complete transit to the DeLong/ELCAS Piers. This included trips to Little Creek for maintenance.
- The shorter delays were usually the result of lighters diverting from the operating lanes while waiting for a pier slot to become available.
- Some delays were caused by LCU's waiting for the tidal current to dissipate before approaching the shore.

Data collectors had no way to evaluate individual transit delays and logged the times as they observed transit completed when the lighter actually started its approach. For example, the holding delay was caused by the fact that the T-ACS could load containers on the LCU's faster than the shore facilities (ELCAS and DeLong Pier) could offload them. Had the lighters held closer to the piers (within 100 yd) while waiting for an offloading slot to be vacated, the data collector could have more accurately judged the completion of the transit leg.

The data remaining after excluding obviously uncharacteristic times still includes lesser delays, but there is no basis for excluding additional data values. What is consistent, is that the time interval under 20 min has the largest data population. For example, the 1600 Class LCU's transiting to the DeLong Pier had 15 out of 35 total points below 20 min, 15 points spread from 21 to 80 minutes, and 5 points from 187 to 997. This last group was excluded. However, the middle group (times from 21 to 80 minutes) is also suspect because of the known characteristics of the LCU. At 6 knots, an LCU can transit one mile in 10 minutes. Add time for maneuvering, acceleration, deceleration, and crabbing in the current and the total should be less than 20 minutes. Therefore, in the remaining average times after excluding obvious extremes, there were delays which might be considered test unique. More reasonable transit times for LCU's are proposed in Section 7.

Transit legs to the Amphibian Discharge Site were more straight forward and did not suffer the delay interruptions like the LCU's. The amphibian site was able to offload lighters much faster than the T-ACS could onload them. Thus, there was seldom a delay while a lighter waited for an open slot. Craft maintenance and fueling breaks for the LACV-30's

was performed at the LACV-30 facility at Fort Story. The craft was offloaded prior to transiting the maintenance facility ramp. The reason for the several LARC-LX delays is unknown. They appeared to have no difficulty with transit.

Manpower. The personnel aboard the lighters are listed below:

1466 LCU	-	14
1600 LCU	-	14
LARC-LX	-	4
LACV-30	-	4

Equipment. The following items were noted:

- None of the Army lighters experienced transit difficulties.
- The availability of the LACV-30's was affected by their constant need for refueling, repair or inspection.

Procedures. The lighters operated between designated beach discharge areas (Amphibian or ELCAS/DeLong) and the T-ACS/TCDF. Their movement to a specific discharge site was controlled by the Lighter Control Center (LCC), responsible for that area. After clearing the T-ACS/TCDF, the lighter would call the LCC and be told to proceed directly to an offloading facility or to hold until a discharge site was open.

Environment. Transit of Army lighters between the ship and beach was not seriously affected by the environmental conditions encountered during test operations. Conditions at the T-ACS/TCDF or beach facilities would prevent loading/offloading of lighters before they were bad enough to seriously affect transit.

Conclusions. Army lighterage experienced little or no difficulty transiting between the T-ACS/TCDF and the beach.

- The transit times recorded for LCU's do not reflect their capability since they include all delays including queues waiting for beach sites and maintenance.
- The transit for the LARC-LX and LACV-30 are relatively fast since they include few delays.

5.2.1.4 Operations at Beach

Army LCU's transited to either the DeLong Pier or ELCAS. LARC-LX and LACV-30 lighters were offloaded at the Amphibian Discharge Site

5.2.1.4.1 Elevated Causeway

Operation of the ELCAS was generally slow during JLOTS II. The reasons for this are varied and include not only procedural and equipment problems (discussed below) but also a generally low motivation encouraged by the small amount of traffic directed to the ELCAS by the Lighterage Control Center.

5.2.1.4.1.1 Approach and Moor

General. The lighters often experienced a great deal of difficulty when approaching and mooring to the ELCAS. Lighter crews and line handlers both displayed a need for training and coordination in this maneuver. Overcoming the wind, waves, and crosscurrents present at the pierhead is critical for efficient use of the ELCAS.

Time. The Army 1600 Class LCU made a total of 19 approaches to the ELCAS. The 1466 Class LCU made only 4 recorded approaches and this is not considered sufficient to demonstrate a time.

The average approach and moor times for the 1600 LCU's are listed in Table 5-25.

TABLE 5-25 - APPROACH AND MOOR TO ELCAS

	Include All Recorded Data		Exclude Extreme Data Values	
Lighter	Average Time (min)	Sample Size	Average Time (min)	Sample Size
1610 LCU	6.9	19	4.3	16

The left two columns include all recorded data. The right two columns show the effect of excluding three values of 25, 25, and 13 min. The remaining 16 values were below 9 min. Because of the numerical grouping, the three excluded times were considered abnormally high and do not appear realistic in an operational environment involving trained personnel. The exclusion of the high values equates to a 38% reduction in approach and moor time for a 16% reduction in sample size.

Manpower. The LCU provided 1 or 2 personnel fore and aft to pass mooring lines up to the pierhead. These were secured by 2 to 4 ELCAS personnel who also handled taglines when moving containers. The number of personnel involved on the pierhead would increase when mooring conditions worsened.

All personnel, especially at the start of the test, appeared to need training. Operations gradually improved, but the anticipation of events and teamwork necessary to make mooring a smooth evolution, never did develop.

A definite need for developing standard procedures and increased training under realistic conditions exists.

Equipment. The major equipment items used during the approach and mooring operation were the landing craft with their mooring lines and the fenders and double bitts of the ELCAS. The following items were noted.

- Additional mooring bitts are needed on the ELCAS to secure lines from several spots on the LCU.

- The safety net adjacent to the fender system interfered with the mooring lines and became more of a safety hazard at times. Crew members on the lighters had to throw the lines over the net to personnel on the ELCAS pierhead. They were not always successful and the line often caught in the net. The extra time needed to retrieve the line was critical to the lighter which would drift away due to the current if the mooring line was not secured quickly.

Procedures. The procedures for approach and moor varied with the changing tide and wind, and also somewhat from LCU to LCU. Generally, when the combined wind and current resulted in the LCU being pushed towards the ELCAS, the procedure was simply a matter of maneuvering the craft parallel to the fenders and letting the current/wind move it into place. Lines were thrown to the pierhead and secured as the craft moved against the fenders.

When the current/wind combination was forcing the LCU away from the ELCAS, the procedure changed. The craft master would maneuver the LCU close enough to throw a bow line across, which had to be quickly secured. This prevented the LCU from drifting while the LCU's stern was swung to the pier. Stern lines were then passed and secured. Finally, the LCU worked against the forward or aft lines to maneuver into a position close to the fenders where it could be reached by the crane.

No standard method of operation was developed for the LCU's, and the ELCAS crew did not perform as a team when handling mooring lines. The ELCAS crew also ignored the safety hazards of mooring lines since they frequently stood behind or next to bitts while a mooring line was stretched taut by an LCU.

Environment. The varying effects of the wind and current are discussed above. Waves would build at the pierhead prior to the surf zone which further complicated the approach and moor by causing the LCU to surge while the mooring lines were being secured. Moving the pierhead (and thus the craft mooring location) further away from the beach would reduce this problem by moving it out of the area where the waves build prior to breaking.

Conclusions.

- Standard mooring procedures should be developed for varying conditions and provided in training and operating manuals for the ELCAS.
- Both LCU and ELCAS crew training should be stressed especially under operating conditions.
- A two-sided pierhead for the ELCAS would permit LCU's to take advantage of the prevailing current/wind conditions.
- The pierhead should be moved beyond the zone of building waves.

5.2.1.4.1.2 Lighter Unloading and Truck Loading

General. Lighters were offloaded by the 140-ton capacity ELCAS container crane. A manual spreader bar was used except for containers with misaligned corner fittings. Special "bent box extractors" were used in those cases. Containers were placed onto 40-ft trailers/yard tractors which had been turned around on the ELCAS turntable.

Time. Table 5-26 summarizes the container offload times at the ELCAS.

TABLE 5-26 - CONTAINER OFFLOAD TIMES AT ELCAS

Elevated Causeway				
Lighter	Per Craft (min)	Per Container (min)	Average No. Containers	Sample Size
1600 LCU	38.3	9.1	4.2	16

Three data values were excluded in the determination of the above averages. One value of 5 min to offload 5 containers is obviously in error. Two high values of 109 min and 171 min to offload 2 and 4 containers, respectively, also are considered erroneous. The remaining 16 times vary from 22 to 67 min with the majority between 30 and 40 min.

Manpower. During operations, an Army crew of 10 people were on the ELCAS: 2 crane operators (alternating about every 2 hr), a signalman/ supervisor, 4 or 5 tagline/mooring line handlers, and 2 or 3 truck traffic directors.

A Navy crew of 4 or 5 personnel was available to do ELCAS maintenance/repairs because it was a Navy ELCAS.

The crews of the lighters assisted by guiding the spreader bar onto the containers and locking it.

Equipment. The following items were noted during operations.

- The "gator holes" in the ELCAS need to be covered during operations. Several people were injured by stepping into these holes or by tripping over protrusions from the deck while handling lines or directing traffic.

- The turntable should be modified to handle the longer Army trailers. Operations were conducted with the turntable out of balance, which places unnecessary strain on the chain drive. Also, the truck had to be pulled as far as possible onto the turntable and, its bumper damaged or interfered with the operation of the truck stops (Figure 5-35).

- The load decoupler was installed on the container crane hook but it did not appear to do any work. By the time conditions were rough enough to

Figure 5-35 - Damage to Turntable Truck Stop

activate the load decoupler, they were already too rough for the lighters to come alongside the ELCAS.

Procedures. The following items were noted:

- Truck drivers were required to stop and put on heavy, thick, life preservers before moving onto the ELCAS, then stop and return them as they departed. The type of life preserver and method of providing them should be reviewed. If needed, light weight, thin, work vest type should be provided in each truck.
- Traffic guides 'walked the trucks' the entire length of the ELCAS roadway. A traffic director at the beach-end and pierhead-end of the roadway is considered adequate.

The truck traffic pattern on the pierhead was established as shown in Figure 5-36. This was not in accord with the pattern recommended in the ELCAS operations manual[8] which is shown in Figure 5-36. The traffic pattern used was intended to allow the trucks to avoid areas of possible damage to their tires. One such area occurred because the pierhead sections were not side-connected together. Instead, 2-1/2-in. high grating was welded across the resulting gap on top of the assembly angles. A second problem area was due the internal spudwells not having covers over them to protect truck tires from the bolts used to pin the causeway sections to the piling.

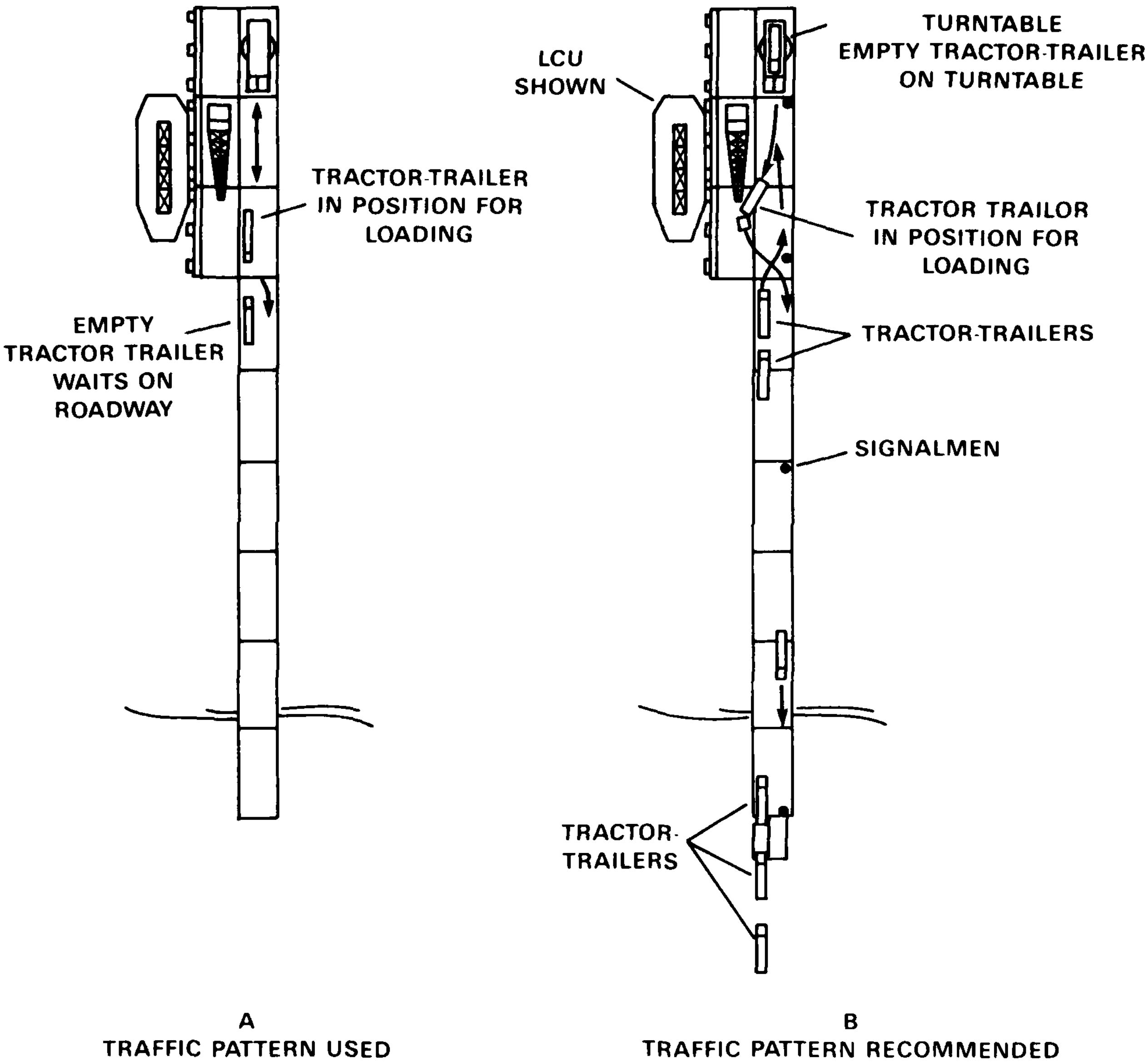

Figure 5-36 - ELCAS Truck Traffic Patterns

The pattern that was used forced the crane to wait for an empty truck since the empty truck had to wait for the previously loaded truck to clear the roadway. Once the loaded truck had departed, the empty one proceeded to the turntable, was turned around, and then moved to the loading spot in front of the crane. The crane took approximately 8.5 min between placing the first and second containers on a truck but 13.3 min between the second container on a truck and the first container on the next truck.

Environment. Offloading operations were affected by wind and waves.

- The crane operators considered it unsafe to work in winds above, roughly, 20 knots due to the wind induced motion of the container and the wind load on the boom. There was not an exact wind speed limit and, each crane operator stopped when he felt it was unsafe. More specific guidance should be developed.

- The ELCAS pierhead was located just beyond the breaking waves in the zone where the waves build prior to breaking. When the waves were 2 ft or greater, they caused the lighter alongside the ELCAS to surge against its mooring lines. This movement made it difficult to place the spreader bar on the containers. Solutions are to increase the length of the ELCAS roadway to move the pierhead into deeper water, further from the building waves and to use slings instead of the spreader bar. A sling that attaches to the bottom corner fittings of the container is recommended since it eliminates the need to climb onto the container.

Conclusions.

- All ELCAS holes and projections should be covered or removed.

- The type of life preserver needed by truck drivers should be reviewed.

- The turntable should be modified to handle the 40-ft trailer/yard tractor combination.

- The truck traffic pattern recommended in the ELCAS manual should be used.

- Slings to container bottom corner fittings should be used to compensate for motion of the lighter.

- The ELCAS should be lengthened enough to move the moored lighters beyond the building waves and reduce their tendency to surge.

5.2.1.4.1.3 Cast-Off and Clear

General. Cast-off and clear from the ELCAS included casting off lines and backing clear of the facility. When the current/wind was pushing the LCU against the fenders some difficulty was experienced.

Time . On the average, the 1600 Class LCU required 2.9 min to cast-off and clear the ELCAS. This was derived by excluding one data value of 56 min from the remaining 18 values all below 9 min. The cause of the extreme value is unknown.

Manpower and Procedure. Two or three personnel cast-off the mooring lines from the pierhead to a corresponding number of lighter personnel who pulled them aboard as this LCU backed away. The LCU cleared the pierhead and then began to turn around to head to the ship.

Equipment. No equipment problems were noted.

Environment. The wind/current could either hold the LCU against the fenders or help it float clear. LCU occasionally had to maneuver carefully to avoid being pushed into the seaward corner of the ELCAS. The LCU could drift a considerable distance down the beach before getting turned around and heading seaward. For this reason, beach discharge facilities should be well separated.

Conclusions. When wind and/or strong currents are present, beach offloading facilities and corresponding lighter traffic lanes should be well separated.

5.2.1.4.2 DeLong Pier

Sandbars on both sides of the DeLong Pier affected operations. The one on the East side was particularly troublesome.

5.2.1.4.2.1 Approach and Moor

General. The approach and moor procedures used at the DeLong Pier generally illustrated the need for training of both lighter crews and line handlers on the pier. Proper procedures should be practiced in frequent training exercises. Although operator capabilities improved as time progressed, they did not appear to evolve into consistent, efficient procedures.

An obstacle to mooring to any pier along a beach is current and wind moving transverse to these piers. This condition is not uncommon. Consequently, procedures must be implemented to operate effectively in a range of current/wind conditions.

Another feature of pier operations to be emphasized is safety. Personnel work at the pier's edge and around taut lines and safe practices must be taught and adhered to.

Time. Table 5-27 lists the average approach and mooring times for the 1466 and 1600 Class LCU's at the DeLong Pier.

TABLE 5-27 - APPROACH AND MOOR TO DELONG PIER

Lighter	Including All Data Values		Excluding Extreme Data	
	Avg Time (min)	Sample Size	Avg Time (min)	Sample Size
1466 LCU	7.6	24	5.6	22
1600 LCU	7.5	35	6.1	33

When extreme data values are excluded, the average drops 26% for an 8% reduction in sample size for the 1466 Class. Similarly, a 6% reduction in sample size for the 1600 Class LCU results in a 19% reduction in average mooring and approach time.

Given the different hull configuration and control arrangement of the two classes of LCU's, it is interesting to note that their times are relatively close.

Manpower. The manning required during the approach and moor operation varied with the conditions. The lighter usually had one or two personnel at the line handling stations fore and aft. The number of line handlers on the pier would tend to increase with adverse tide and wind conditions, although there did not appear to be a set number.

What did stand out was the need for a detailed operation procedure and for crew training both on the part of lighter crews and line handling

personnel on the pier. The craft masters did not demonstrate the skill/confidence in controlling the dynamics of their craft and in the proper use of lines to assist in coming alongside that was expected for an operational test that was planned well in advance. The pierside line handlers did not demonstrate a lack of understanding of line usage and of safety hazards associated with handling lines under heavy loads. They often stood in way of a line stretched taut to a lighter.

Equipment. The primary equipment items utilized during the approach and mooring operation were the bitts on the pier edge for securing lines.

Procedures. The procedures used were not consistent and frequently not in accordance with good seamanship. In general, however, two types of approaches were made: when ambient conditions set the craft away from the pier and when they set craft onto the pier.

When the wind/current combined to set the craft onto the pier the approach and moor was relatively simple. The craft would usually maneuver adjacent to the pierside and drift into the fenders. However, when conditions combined to set the craft away from the pier, the successful procedure was to approach close enough to pass and secure a bow line, then use propulsion to swing the lighter's stern toward the pier so that stern lines could be passed and secured. Frequently, however, the approach was too far off to pass lines or the craft master was unable to rotate the craft around a secured bow line. There were many occasions when line handlers were not in position to handle lines at the edge of the pier. This contributed to missed moorings, because the lighter would drift away unless the bow line was passed and secured promptly.

Environment. As has been described, the current and wind had significant effect on the approach and mooring operation. Low tide occasionally stopped approach and mooring to the pier, especially on the east side of the pier because of shallow water over the sandbar.

Conclusions.

- If not already included, standard operating procedures should be promulgated in operating manuals for DeLong Pier operations.
- Crew training is essential for efficient and safe operations.
- In geographical areas where low tide interferes with operations, additional pier units should be installed to move the lighter berthing area seaward.

5.2.1.4.2.2 Lighter Unloading and Truck Loading

General. Lighters were offloaded on both sides of the DeLong Pier by 140-ton truck cranes positioned adjacent to each side. Manual spreader bars were used except for containers with misaligned corner fittings. Special "bent box extractors" were used in those cases. Containers were loaded directly onto Army 40-ft trailers/yard tractors parked longitudinally on the pier. This layout is shown in Figure 5-37. The operation was slowed somewhat by a lack of specific operating procedures and a lack of personnel experience.

Time. Table 5-28 summarizes the container offload times across the Delong Pier.

TABLE 5-28 - CONTAINER OFFLOAD TIMES DELONG PIER

Lighter	Per Craft (min)	Per Container (min)	Average No. Containers	Sample Size
1466 LCU	46.5	8.2	5.7	22
1610 LCU	25.5	5.9	4.3	35

One possible explanation for the difference in time to offload a container from the two classes of LCU is offered: The 1466 Class LCU was loaded several ways. Some were loaded with 6 containers oriented transverse to the lighter. Others were loaded longitudinally with up to 3 abreast in 2 rows and 2 abreast forward for a total of 8 (Figure 5-38). The 1600 Class was restricted to containers longitudinally loaded end-to-end with, at times, two containers abreast in the stern position for a maximum of 5 as shown in Figure 5-39. The more "densely packed" configuration of the 1466 Class LCU may have created additional interference to tag line handlers than experienced on the 1600 Class, resulting in longer crane cycle times.

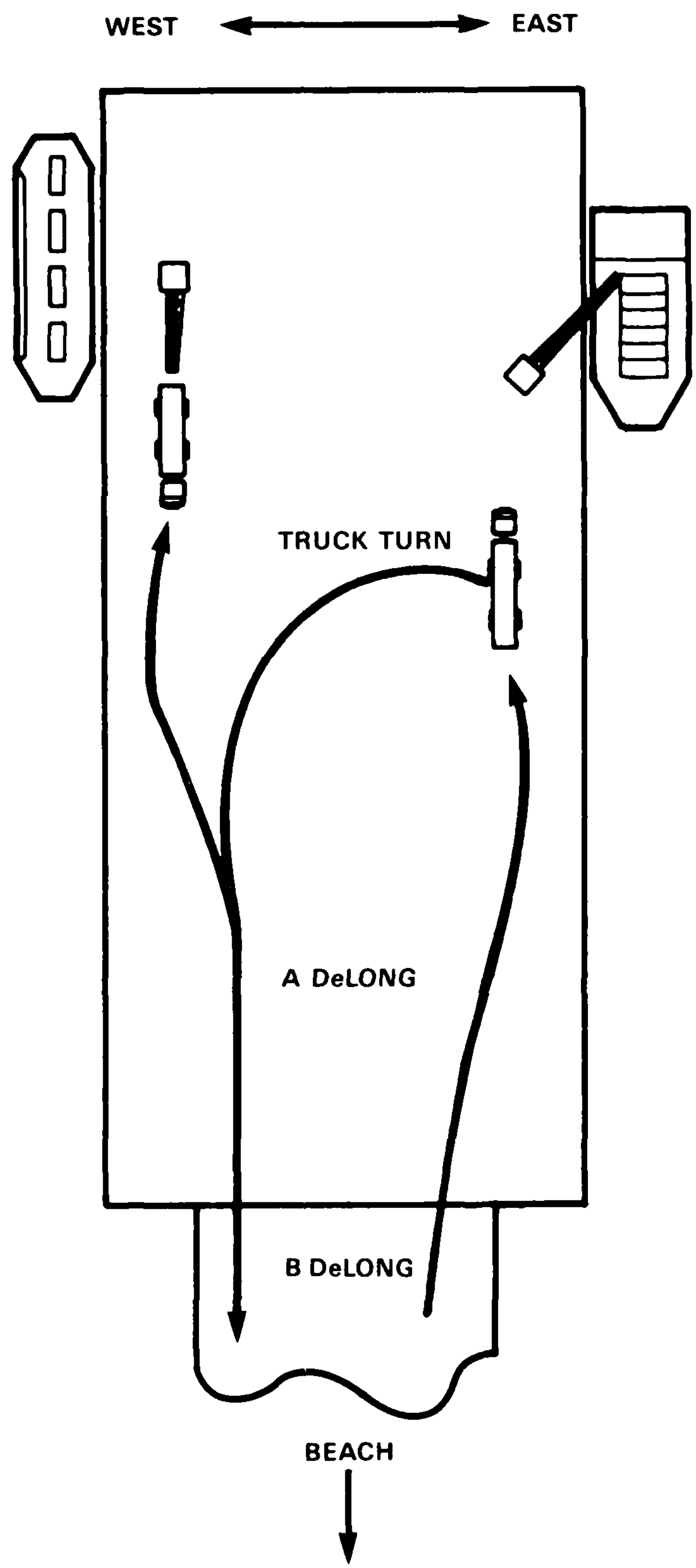

Figure 5-37 - DeLong Pier Procedure

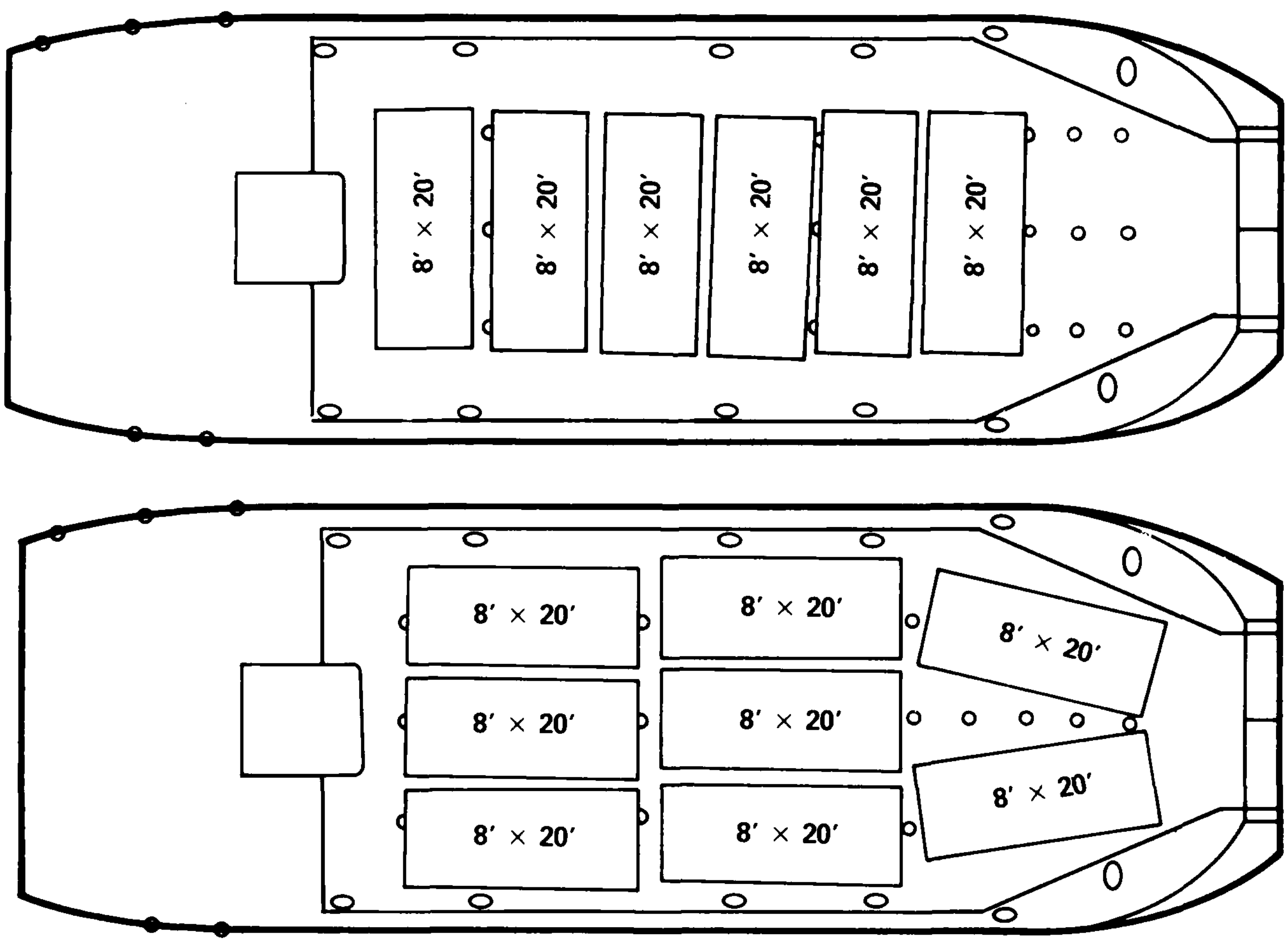

Figure 5-38 - Two Arrangements for Loading 8-Foot by 20-Foot Containers Aboard the 1466 Class LCU

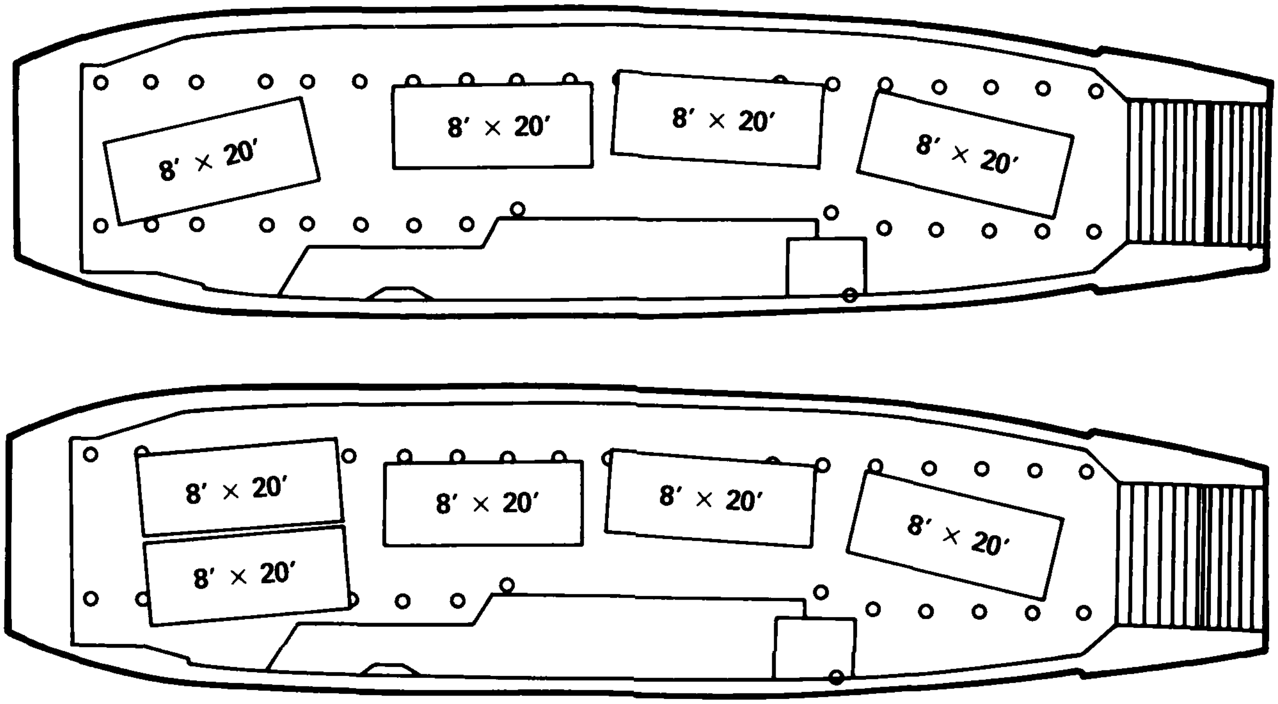

Figure 5-39 - Two Arrangements for Loading 8-Foot by 20-Foot Containers Aboard the 1600 Class LCU

Since the 1600 Class carries fewer containers on the average, it requires more frequent mooring and cast-off operations than the 1466 Class. This tends to increase the average time per container that the 1600 LCU occupies a berth at the DeLong Pier over an extended period and will tend to reduce the time difference between the two classes of LCU's.

Manpower. The typical manning level recorded during offload operations at the DeLong Pier was 8 personnel on each side. The distribution was as follows:

1 - Crane Operator
2 - Signalmen
5 - Line Handlers

A major comment by the data team observing the offload operation was the obvious lack of experience of the personnel involved. Some of the crane operators had never handled spreader bars and containers. This lack of experience definitely influenced the timed performance measured in this test.

One safety hazard noted was personnel walking under containers held by a crane. This is poor practice under any conditions, especially when the brake for the hoist drum reportedly slips.

Equipment. The equipment used to offload containers at the DeLong Pier is listed below:

1 - B-DeLong Pier
1 - A-DeLong Pier
1 - Ramp
2 - 140-Ton Truck Cranes
2 - 20-Ft Spreader Bars
2 - Bent Container Extractors
2 - Container Slings

The equipment was rugged and simple and, for the most part, performed satisfactorily. Several alternator failures occurred on the cranes and the hook lift line brake was observed to slip on several occasions. These difficulties were worked around.

The deck of the piers was planked with two layers of timbers with a heavy asphalt coating between layers. The asphalt tended to bleed to the surface in the hot sun and became messy in spots.

The trucks had difficulty climbing the slippery ramp early in the offload. Sand on the tires roughened the ramp surface which eased the slipping problem somewhat. Observations were not made under rainy conditions.

The 40-ft trailer has 3 tandem axles (12 wheels). The 180-deg turn, required on the pier, was made with the tractor 90 deg to the trailer causing tires to "skid" around (see Figure 5-37). This skidding caused wear on both the tires and the pier surface. Attempts were made to reduce the frictional drag by coating the deck with sand and, at other times, wetting the deck. Neither technique seemed to relieve the skid problem.

There were frequent occurrences where the offload operation waited for trucks, i.e., there were none in the queue. There was no deficiency in the number of trucks provided. They were just not dispatched in a timely manner.

Procedures. The following procedures were used during the test.

- An empty truck coming onto the pier for loading at the west crane would first make a 180 deg left turn, then back under the crane (Figure 5-37).

An empty truck destined for loading at the east crane would drive forward to the crane, receive two containers on its trailer, then make the 180 deg left turn for its departure from the pier.

- The cranes used 20-ft spreader bars with tag lines to lift the containers from the LCU's alongside and load them onto awaiting trucks.

- Containers were secured to the trailer with corner locking fittings built onto the trailers.

- "Bent box extractors" were used in place of the spreader bars to lift containers with corner fittings bent or out of alignment.

An alternate procedure for pier operations was considered, but not used. This procedure involved the use of RTCH's to load containers onto trucks after the container had been moved from a lighter to the pier by the 140-ton crane. This procedure might have increased the container rate since the RTCH can align itself with the container and load it on the truck more rapidly than the crane. Also, the RTCH could continue working during the cast-off of an empty LCU and the mooring of a loaded one. This process would have allowed the lighters to cycle faster.

An Army funded study indicated the deck of the A-DeLong Pier could not support the RTCH load. Therefore the procedure was not used.

Environment. Waves and wind were the only environmental factors which interfered with offloading operations on the pier. The cranes could not operate safely in winds above about 20 knots Container offloading was affected by craft motion resulting from wave action at the pierhead.

Conclusions.

- Approved written procedures, including safety procedures, should be available to operating personnel.

- Crew training is needed.

- The use of slings, vice the spreader bar, might improve the container rate (as aboard the T-ACS).
- Consideration should be given to reinforcing the A-DeLong deck to support RTCH operations.
- Correct the problem of the slipping brake for the crane's lift lines.
- Improve the surface of the A-DeLong to reduce the frictional wear on truck tires during turning.
- Clean up the asphalt which bleeds through the planking of the B-DeLong Pier.
- Install a turntable to turn trucks on the pier.

5.2.1.4.2.3 Cast-Off and Clear

General. Cast-off and clear from the DeLong Pier included casting off lines and backing clear of the facility to a point where the LCU could start its turn. This was a relatively simple procedure albeit a little more difficult from the upcurrent side of the pier because of the force holding the craft against the fenders.

Times. Recorded times for this maneuver are tabulated in Table 5-29.

TABLE 5-29 - CAST-OFF AND CLEAR FROM DELONG PIER

Lighter	Includes all Data		Excludes Extreme Times	
	Average Time	Sample Size	Average Time	Sample Size
1466 LCU	9.8	24	7.4	22
1600 LCU	15.8	35	6.9	33

In comparing the two sets of data, it can be seen that the average cast-off and clear times were significantly affected by a small percentage of the cases. For the 1466 Class LCU, the average time was reduced by 24% by excluding the two highest data values (the highest 8% of the data). The 1600 Class LCU average time is reduced by 56% by excluding the highest two data values (6% of the data). Possibly of more value for planning purposes is the fact that 71% of the data values were 8 min and below for the

1466 Class and 7 min and below for the 1600 Class. If these lower 71% of the data points were averaged, the results would be cast-off and clear times of 4 min and 3.1 min for the 1466 and 1600 Class LCU's, respectively.

Some possible reasons for the high data values in each case are:

- Poor interpretation by the data collector of the completion of clearing
- Administrative delays
- Delays caused by the sandbar at low tide
- Delays caused by the lighter being held against the pier by high current/wind forces

The times for the two classes of lighters are fairly close if the several extreme values are eliminated, whereas they are significantly different when all recorded times are included. This could imply that the averages, excluding extreme data recordings, are more realistic since the two types of LCU's have similar backing capabilities.

Manpower. The manning during cast-off and clear operations included the lighter crew and personnel on the pier to cast-off lines.

Equipment. No support equipment was required for this operation.

Procedure. Upon completion of offload, the craft master would prepare his lighter for cast-off. Lighter crew would retrieve lines cast-off from the pier and the lighter would be backed seaward to a position considered safe to initiate a turn around maneuver. This completed clearing.

Environment. The wind and current were problems during cast-off and clear. The upstream/upwind lighter would have to contend with the force holding it against the pier. The downwind/downcurrent craft floated free upon cast-off of lines. Most craft masters had difficulty backing straight out from the pier in a current situation. At times significant lateral drift occurred before they were clear resulting in several near collisions with the elevated causeway.

Conclusion. Because of lateral drift during clearing of the lighter, the adjacent pier facilities should be separated by 300 yd to allow sufficient maneuvering room.

5.2.1.4.3 Amphibian Discharge Site

5.2.1.4.3.1 Approach and Moor

General. The Amphibian Discharge Site was the offload facility for both the LACV-30's and LARC-LX's. The approach and moor operation consisted of the lighters transiting the surf and climbing about 30 yd of shallow beach slope to the offload position beside one of the two cranes which were stationed on the beach side of the berm.

Time. The approach and moor was the terminal of the transit from ship to shore and there was no distinguishable boundary between the two. Therefore, no separate approach and moor times were recorded. The overall transit leg was affected, however, by occasional difficulties in positioning the LACV-30 in the offload spot. If the lighter maneuvering track was not level, the LACV-30 tended to slip off of the "hill". The LARC had no positioning difficulties.

Manpower. The manning involved in the positioning of the lighter included the craft crew and a signalman standing on the berm.

Equipment. No special support equipment was required aside from lights/wands for night operations.

Procedure. The craft slowed from transit speed to an approach speed just prior to reaching the surf zone and proceeded onto the beach and directly into the site. A signalman directed the LACV to settle off cushion when appropriately positioned in the offload area. If the LACV hovered too long in a local area, it would blow sand from under the cushion causing a local slope away from the berm. The longer the craft hovered, the greater the ground erosion and the more difficult to maneuver into and out of position.

Erosion caused by maneuvering craft, LARC tires, and high tide resulted in a requirement for continual maintenance of the site using dozers to level the sand.

Environment - The primary environmental hazard during approach and moor operations at the Amphibian Discharge Site was an occasional high tide which eroded the lighter maneuvering track. Wind caused the sand, raised by the LACV cushion air flow, to blow and create adverse conditions for the signalman while directing the craft into position. Wind also effected the control of the craft while maneuvering in the site.

Conclusions. The approach and mooring of the LACV-30 in the Amphibian Discharge Site is effected by the condition of the lighter maneuvering track. If not relatively level and flat, the craft has difficulty maneuvering into position for offload. If the track slants into the berm, the craft has difficulties withdrawing after offload. Therefore continual berm maintenance is required.

The LARC-LX had no difficulty maneuvering into and out of the site.

5.2.1.4.3.2 Lighter Unloading and Truck Loading

General. The offload of the LACV-30 and LARC-LX lighters at the Amphibian Discharge Site demonstrated a rapid container rate and the crews operating the site appeared to improve their skills as time progressed. The maximum performance of personnel and equipment occurred on 9 October, when only LACV-30's were used and were pressed for maximum throughput in the offload operation.

Time. The crane cycle times for offload of the LACV-30 and LARC-LX operations at the Amphibian Discharge Site are listed in Table 5-30.

TABLE 5-30 - AMPHIBIAN DISCHARGE SITE OFFLOAD TIMES

Lighter	Average Offload Time (min)	Average Container Load	Sample Size	Average Time Per Container (min)
LARC-LX	6.6	2.1	60	3.2
LACV-30	5.1	2.0	196	2.6

Both craft carried two containers per trip except for several occasions when the LARC-LX carried 4 (two tiers). The time differences for offloading these two lighters reflects the greater time required for tagline handlers to get on and off the LARC as compared with the LACV-30. The containers were longitudinally loaded end-to-end on the LARC and side-by-side and transversly on the LACV. However, tolerances were

sufficient in either case for the spreader bar alignment operation so it is doubtful that the container orientation affected offloading time.

Manpower. The manning utilized during container offloading is given in Table 5-31. The quantities are for one offload position at the berm using the maximum manning used. Operations were frequently performed with fewer personnel.

As time progressed, proficiencies improved. One area which was slow to improve was spotting the containers onto the truck from the RTCH. Tagline handlers increased their speed on and off the craft and over the berm, but at an increased safety risk. They began using the taglines to help them move from the craft and across the berm as the crane swung the container. This is unsafe especially since the crane's lift line brake had a tendency to slip.

The crane operator's tended to get reckless as their speed increased causing containers to "swing dangerously", according to observer comments.

In general, the personnel initially appeared to lack training, but improved their proficiency as the test progressed. Had they been trained prior to the test, it is expected that the average times would have been shorter than those recorded.

TABLE 5-31 - AMPHIBIAN DISCHARGE SITE
MANNING PROFILE

Position	Number
Crane Operator	1
Tagline Handlers	4
Crane Signalman	2
RTCH Operator	1
RTCH Signalman	1
Dozer Operator	1
Supervisor	1

Equipment. Typical equipment used during the container offload at the Amphibian Discharge Site is given in Table 5-32. The listing is for a single offload position.

TABLE 5-32 - AMPHIBIAN DISCHARGE SITE EQUIPMENT

Item	Number
RTCH	1
140-Ton Crane	1
Dozer	1
20-Ft & 40-Ft Manual Spreaderbars	1 ea
Bent Box Extractors	1 set

In general, the equipment worked well as a beach side offload system. An observed problem was slipping of the crane's lift line. This resulted in lowering the container unexpectedly or at an unintended location. On one occasion, a container slipped down onto a LACV-30 life raft container. This is a correctable problem and should be attended to because of the safety hazard it presents.

Procedures. The offload procedures were the same for both the LACV-30 and the LARC-LX.

- Once the craft was in the offload position under the crane, the tagline handlers would cross the berm and climb on board while the crane operator swung the spreader bar overhead to a position above the container.
- The spreader bar was attached to the corner fittings with assistance of the tagline handlers.
- The container was lifted out of the craft and deposited on the ground on the beach side of the berm.
- A RTCH transferred the container to a truck behind the berm.
- Bent/misaligned containers were offloaded with bent box extractors.

- There were frequent periods when trucks were not available. When this occurred, the RTCH's stacked containers on the beach. As trucks became available, they moved those containers to the Marshalling Yard.

Conclusions.

- The truck queuing/staging was frequently deficient. This requires better planning.
- Personnel performance improved during the test with the increase of some unsafe practices such as swinging on the taglines, swinging the containers too rapidly, and allowing the crane lift lines to slip without correcting the problem.
- The MOMAT truck mat provided an excellent base for truck traffic as long as periodic maintenance was performed on the roadbed.
- The system of handling containers by a combination of the 140-ton crane-to-RTCH-to-truck worked well.

5.2.1.4.3.3 Cast-Off and Clear

General. Upon completion of container offloading, the LACV-30/LARC would depart the site into the surf and proceed with the next container delivery cycle.

Time. The cast-off and clear times are noted in Table 5-33.

TABLE 5-33 - CAST-OFF AND CLEAR
AMPHIBIAN DISCHARGE SITE

Lighter	Average Time (min)	Sample Size
LACV-30	1.9	196
LARC-LX	1.5	60

The comparative times are essentially equal within the accuracy of the recorded data.

Manpower. Under normal operating conditions, the only manpower required during cast-off and clear were the craft crew and the signalman on the berm in control of the operation.

Equipment. No support equipment was required in the clearing operation.

Procedure. Under the guidance of the signalman the lighters maneuvered out of the site, avoiding the other offload position, and entered the surf.

Environment. The environmental condition which most affected the Cast-Off and Clear operation was the wind. Under certain conditions, it made it difficult for the LACV-30 to gain sufficient control to rotate out of the offload position.

Conclusions.

- The LARC-LX has no difficulty performing the cast-off and clear operation at the amphibious discharge site.
- The LACV-30 has occasional difficulties clearing the facility because of eroded conditions of the lighter maneuvering area and/or the adverse wind direction and velocity.
- On the average the clear time is essentially the same for both craft.

5.2.1.4.4 Truck Transit

US Army 5-ton yard tractors pulling 40-ft trailers were used throughout the Army portion of JLOTS II. The trailers carry two 20-ft containers each. Table 5-34 contains a breakdown of the time required to secure the containers to the trucks and for the truck to transit to Marshalling Yard A from the three beach offloading sites. Return transit times were not recorded since the trucks would return to a multi-vehicle queue at the beach or go to be refueled or maintained.

The time to secure the containers to the truck is the time difference between placing the second container on the truck and the truck's departure. This time is greater on the ELCAS than at the other sites for unknown reasons. A planning time of 3 min appears appropriate for this event.

5.2.1.4.4.1 Beach to Marshalling Yard

The transit times listed in Table 5-34, are for a transit distance to Marshalling Yard A of approximately 1.2 mi. The same one-way road system was used as during the Navy/USMC operations (refer to Figure 3-16). There were traffic control points at several locations to halt other traffic so the truck transit was virtually non-stop from the beach to the Marshalling

Yard. Just prior to leaving the beach the truck was stopped and the container numbers recorded for cargo documentation. This stop averaged approximately 1 min.

TABLE 5-34 - TRUCK TRANSIT TIMES

		From DeLong	From ELCAS	From AMPHIB	Avg from All Locations
Day	Secure Cont.	1.5	6.7	2.4	3.6
	Transit	10.2	11.4	11.5	11.0
Night	Secure Cont.	2.1	3.9	4.1	2.8
	Transit	13.7	16.0	11.8	13.8
Day & Night	Secure Cont.	1.9	5.6	3.3	3.2
	Transit	12.0	13.7	11.7	12.4

The average transit time from the ELCAS is slightly larger than from either the DeLong or the Amphibian area. It is believed that this is due to the use of personnel to guide the trucks along the entire length of the ELCAS. Also, all personnel were required to wear life preservers on the ELCAS, so the truck drivers picked one up at the beach end of the roadway when going on, and had to stop and return it when departing with containers.

A truck speed of 10 mph is recommended when calculating an estimated transit time at similar operation locations.

5.2.1.4.4.2 Truck Unloading in Marshalling Yard

Marshalling Yard A was used as the principal container storage area with Yard B as an overflow area. The Army used the same layout and stacking technique used by the Marine Corps (shown in Figure 3-35). Truck offloading was done completely by RTCH's. Each RTCH had two people assigned to it, an operator and a director. Four personnel assisted the RTCH in removing the containers from the truck by releasing the corner locks. These personnel stayed in the truck offloading area and were not assigned to one RTCH. As with the Marine Corps, no problems were experienced by the RTCH's with the terrain or spacing in the Marshalling Yard. Occasionally the dust would become severe and hamper visibility, however. This problem could be removed by having a water tanker spray the area occasionally.

A truck carrying 2 containers was offloaded in an average of 3.1 min. This average includes the transit time of the truck inside the yard and any delays due to a queue of truck traffic.

5.2.1.5 Backloading Operations

Container backloading was required to ensure sufficient containers were onboard the containership for the Army phase of the test. Backloading began on 24 September under Navy control, and was terminated by the Army on 3 October after some weather delays. The Army had assumed operational control on 1 October in the midst of backloading. After four days of offloading, the Army backloaded for three shifts, starting with the night of 7 October. The purpose of this backload was to get the EXPORT LEADER loaded to the desired configuration to accommodate an offload test concentrating on LACV-30's.

5.2.1.5.1 Offshore Operations

Four-point slings were employed by the T-ACS cranes for backloading. This was easier than using spreader bars since the lighter has more sea-induced motion and the slings do not require exact positioning for attaching to the container. There were some problems experienced while placing containers into cell guides in the holds of the EXPORT LEADER, often because of eccentric container stuffing and the inability of the slings to compensate for an off-center load. A total of eight shifts

under Army direction were used for backloading during the two periods of 1-3 October and 7-8 October.

A total of 743 containers were backloaded during the Army test period as listed on Table 5-35.

TABLE 5-35 - CONTAINERS BACKLOADED BY ARMY

Date	Day Shift	Night Shift	Total
1 Oct	32	-	32
2 Oct	21	55	76
3 Oct	104	91	195
7 Oct	-	151	151
8 Oct	157	132	289
TOTAL	314	429	743

It is interesting to note that the 151 containers backloaded on the 7 October night shift and the 157 backloaded on the 8 October day shift are shift movement totals exceeded only by the 187 offloaded by LACV-30 lighters during the 9 October day shift. The 151 and 157 container shift totals were accomplished by LCU lighters exclusively.

5.2.1.5.2 Beach and Onshore Operations

The backloading of containers from the Marshalling Yard to the ship was basically the reverse of the offload. Trucks were loaded in the Marshalling Yards by RTCH's, they proceeded to the beach where they were directed to an open facility. The lighters approached and moored at the facilities, and the containers were placed in them for transit to the ship.

5.2.1.6 LACV-30 Availability and Support Requirements

The LACV-30 as a LOTS lighter provides the operational capability of a high speed amphibian. Where this capability is needed, no other lighter operated in JLOTS II can compare. Along with the unique capability, the

LACV-30 brings the requirement for significantly higher levels of maintenance and fuel support as well as higher procurement costs. As examples:

- Two days prior to the LACV-30 full thrust shift on 9 October, nine of the twelve LACV-30's were deadlined for various reasons. An "all hands" around the clock effort was required to prepare the craft.
- It is estimated that the fuel required by LACV-30 per container delivered ashore is over 20 times greater than that required by a Causeway Ferry (CSP plus three unpowered sections).

5.2.2 Breakbulk Operations

The opportunity afforded by breakbulk ship operations enabled each service to test its capability to simultaneously move containers and palletized cargo to the beach. The Army used the breakbulk ship, SS CAPE ANN, that was acquired by JLOTS II for the test.

Like the Navy/USMC phase, the Army breakbulk throughput test started with the SS CAPE ANN loaded with approximately 2100 STons of palletized training cargo. The ship loadout was accomplished by backloading all the cargo offloaded during the Navy/USMC throughput portion of the test.

5.2.2.1 Operations at Breakbulk Ship

The Army took over operations on 1 October and finished the backloading of the SS CAPE ANN started by the Navy.

The throughput operations at the breakbulk ship commenced on 4 October with LCM-8's and LARC-LX's positioned on both the port and starboard sides of the ship. An average of 303 STons of palletized cargo was transferred ashore during a 10-hr shift. Handling of the palletized training cargo is shown in Figures 5-40 and 5-41.

5.2.2.2 Lighter Transit

The basic purpose of the breakbulk operations, as discussed in Section 3.2.2.2 for the Navy offload, was to evaluate the effect breakbulk operations would have on container throughput. The movement of lighters to and from the beach was considered a possible area of interference by complicating traffic control and increasing the complexity of the traffic

Figure 5-40 - Breakbulk Cargo Being Removed from Hold of SS CAPE ANN

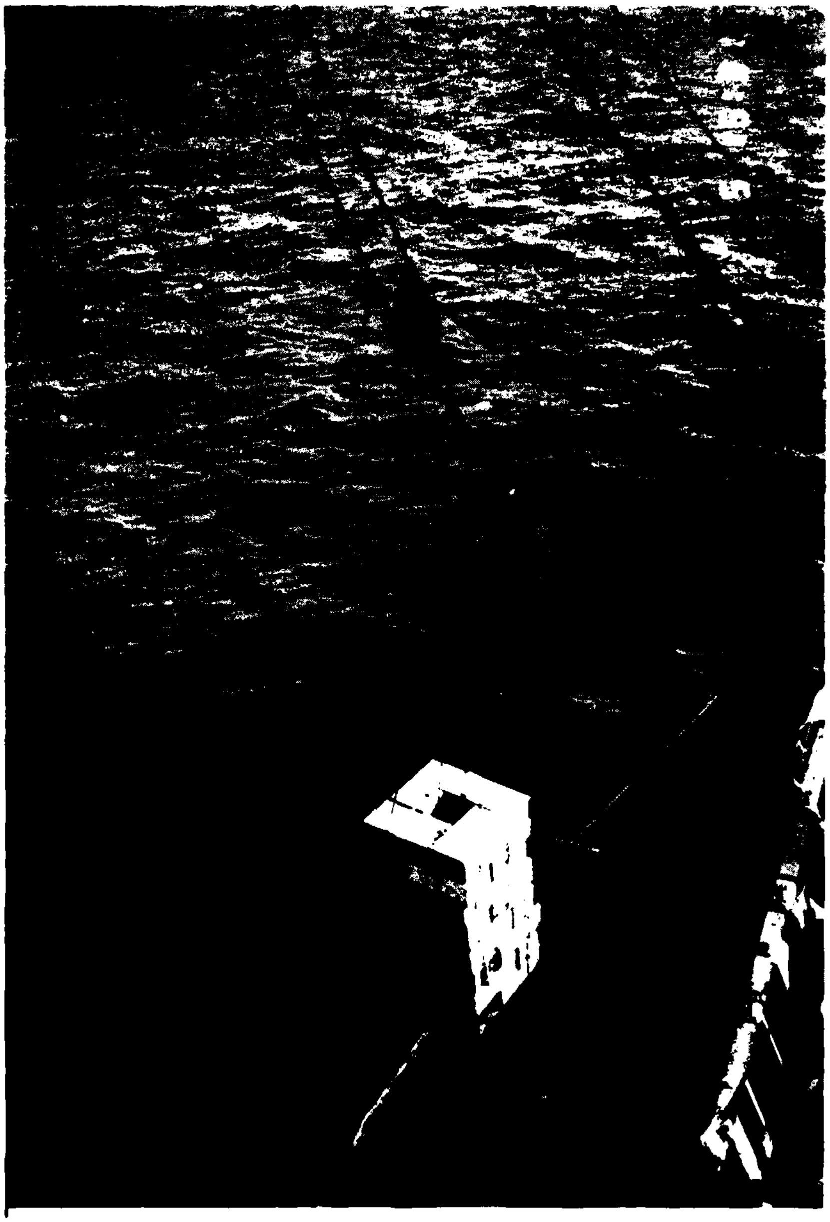

Figure 5-41 - Breakbulk Cargo Being Loaded into LCM-8

flow which the lighters had to negotiate. Figure 5-42 displays the traffic pattern used. Table 5-36 lists the number of lighter trips made to the breakbulk area versus the number of lighter trips made to the ELCAS and DeLong for each shift of operation. The movement of lighters from the container ship to the Amphibian Discharge Site (LACV-30 and LARC-LX) did not cross the traffic pattern of the breakbulk lighters, and they were controlled by a separate lighter control center.

No interference between lighters with containers and those with breakbulk was noted. Lighters were appropriately lit for night operations and standard rules of the road were used when lighters crossed paths. The lighter control center had no problem keeping track and directing the lighters.

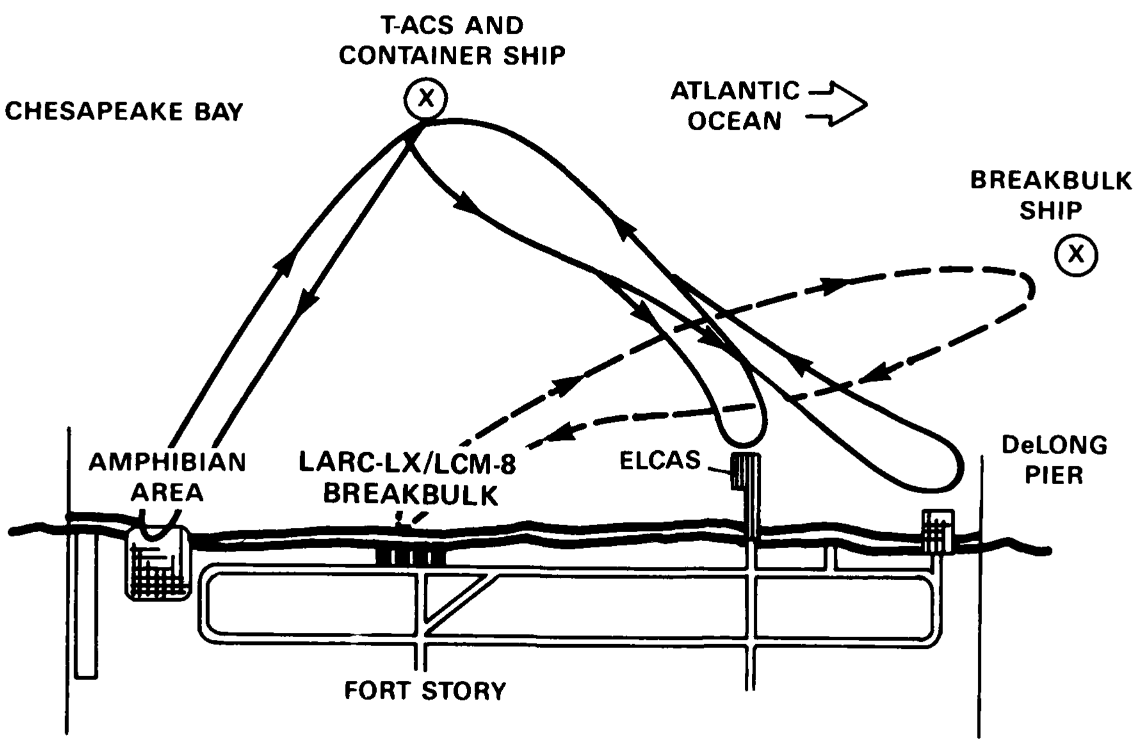

Figure 5-42 - Traffic Pattern for Army Lighters

TABLE 5-36 - ARMY BREAKBULK AND CONTAINER LIGHTER TRIPS

Shift		Breakbulk Lighters			Container Lighters			
		LCM-8	LARC-LX	Total	LCU	LARC-LX	LACV-30	Total
4 Oct	D	9	6	15	12	1	16	29
	N	16	3	19	20	3	21	44
5 Oct	D	9	5	14	17	1	19	37
	N	3	1	4	9	3	14	26
6 Oct	D	-	-	-	2	3	1	6
	N	-	-	-	-	-	-	-
7 Oct	D	-	-	-	-	-	48	48
	N	-	-	-	-	-	-	-
8 Oct	D	-	-	-	-	-	-	-
	N	22	-	22	-	-	-	-
9 Oct	D	-	-	-	-	-	94	94
	N	-	-	-	13	-	26	39
10 Oct	D	-	-	-	10	12	10	32
	N	-	-	-	-	-	-	-

5.2.2.3 Operations at the Beach

5.2.2.3.1 Approach and Moor

Army breakbulk cargo was carried in LCM 8's and LARC-LX's. Approach and mooring times were not recorded. The goal was to ride up on the beach to the point of achieving a dry ramp. However, a foot or so of water at the ramp did not hinder offloading operations.

The breakbulk offloading area was between the ELCAS and the Amphibian Discharge Site. There was more room in the Army beach arrangement than during the Navy test. Therefore, breakbulk lighters did not interfere with craft approach/clearing the other facilities.

5.2.2.3.2 Lighter Unloading and Truck Loading

Offload time for the two types of lighters are given in Table 5-37.

TABLE 5-37 - OFFLOAD TIMES
ARMY BREAKBULK OPERATIONS

Lighter	Average No. of Pallets	Offload Time (min)	Time Per Pallet (min)
LCM-8's	18.7	22.7	1.2
LARC-LX's	26.2	35.3	1.3

The offload of pallets was performed using a combination of 6,000 lb and 10,000 lb RTFL's. The 10,000 lb capacity forklift was best for going aboard the craft and retrieving the pallets. It appeared to have more traction on the lighter ramps and was more stable in its transition on and off the lighter. It would stack the pallets on the beach on the water side of the roadway and the 6,000 lb and 4,000 lb capacity forklifts would load trucks from the stack. When no trucks were available, they would restack the pallets on the inland side of the roadway.

At times, the breakbulk operations caused some traffic congestion with the steady flow of trucks to the Amphibian Discharge Site. Later in the test, the trucks to the amphibian site took a different route and the congestion was relieved.

Breakbulk cargo pallets were frequently dropped and broken. Damage suffered was sufficient to warrant setting up a pallet repair activity on the beach. The broken pallets were reassembled, restrapped, and reentered into the test.

5.2.2.3.3 Cast-Off and Clear

This phase of the breakbulk cycle was not time recorded.

5.2.2.3.4 Truck Transit and Offload

The route from the breakbulk area on the beach to the breakbulk cargo yard, Marshalling Yard C, was partially the same as the route for containers going to Marshalling Yards A and B (refer to Figure 3-16). Since the roadway was established as a one-way loop and the yards were well separated, no interference occurred between the breakbulk and container truck traffic.

The breakbulk Marshalling Yard was arranged similar to the container Marshalling Yards, rows of pallets were arranged 20-ft apart to allow the forklifts maneuvering room to stack and retrieve pallets. The trucks were offloaded by as many as six 4000 lb or 6000 lb RTFL's at a time.

5.2.3 Bulk Liquid Throughput

5.2.3.1 ROWPU

General. ROWPU operations were conducted during the period 18-23 September under the direction of civilian R&D personnel with contractor assistance for maintenance and repair. Many problems were encountered which resulted in an average production of 228,000 gal per day (gpd) instead of the goal of 300,000 gpd. An average of 193,000 gpd were pumped to shore while the remainder was used to backflush the system or was pumped overboard.

Time. Water production took place during three time periods. The first and second were during and following the initial installation on 18 and 20 September. The third took place following the second installation of the barge and ran around the clock from 1100, 21 September to 0700, 23 September. Table 5-38 provides a summary of the production and down times. Table 5-39 lists operating times of each ROWPU unit and related major events.

TABLE 5-38 ROWPU POTABLE WATER PRODUCTION

JLOTS DEMO TOTALS										
Avail Operating Hours	Unscheduled Maintenance Hours		Scheduled Maintenance Hours		Operation Hours		Water Produced (Gal)		Total Water Produced (Gal)	Total Water Pumped To Shore (gal)
	Port ROWPU	STBD ROWPU	Port ROWPU	Port ROWPU	Port	STBD	Port	STBD		
47.2	1.1	2.1	8.3	8.1	39.3	35.5	220,040	228,940	448,980	379,000
24 Hr Avg *	0.5	1.1	4.2	4.1	19.4	18.6	108,000	120,000	228,000	193,000

* Average of total available hours for each ROWPU unit

TABLE 5-39 - ROWPU OPERATIONS EVENT TIMES

Date	Time	Event
9/18/84	1330-1530	ROWPU #1 operated approximately 30 min and produced about 5,530 gal.
	1400-1535	ROWPU #2 operated approximately 1 hr and produced about 8,340 gal.
9/20/84	0900-1920	ROWPU #1 operated approximately 2 hr and 30 min and produced about 11,420 gal.
	0930-1920	ROWPU #2 operated approximately 2 hr and produced about 12,870 gal.
	1415-1950	ROWPU redeployed
9/21/84	1100-2400	ROWPU #1 operated approximately 9 hr and produced about 57,500 gal.
	1400-2400	ROWPU #2 operated approximately 8 hr and produced about 49,400 gal.
9/22/84	0005-2325	ROWPU #1 operated approximately 17 hr and produced about 103,000 gal.
	0005-2400	ROWPU #2 operated approximately 16 hr and produced about 123,000 gal.
9/23/84	0005-0700	ROWPU #1 operated approximately 6 hr and produced about 42,000 gal.
	0005-0700	ROWPU #2 operated approximately 5 hr and produced about 35,000 gal.
	0825-1000	Hoseline recovered.
	1000-1140	Anchors recovered.
	1140-1400	Attempted practice redeployment.
	1400	ROWPU barge departed.

Manpower. The same personnel were used for installation and for operation. The crew was fairly well trained in operation and maintenance of the barge systems with the exception of the chlorination system which had not been operable prior to JLOTS II. The supervisors were not as knowledgeable as the crew members because they were not present during all training sessions and showed no initiative to learn. Personnel on hand are listed in Table 5-40.

The crew was split into two teams. Prior operations and training had been done with four smaller teams. The two-team method worked well for 24-hr operations and was recommended by the Army independent evaluators. The Army evaluators recommended revising the crew list to include personnel trained in handling and working aboard watercraft. The recommended personnel are listed in Table 5-41.

TABLE 5-40 - ROWPU PERSONNEL ON HAND

Description	Grade	MOS	No. on Hand	Unit
Water Purification Spec	E-5	51N	3	26th EN Detach 561st Bn. Ft Campbell, KY
Water Purification Spec	E1/4	51N	7	
Plumber	E-5	51K	1	
Plumber	E1/4	51K	2	
Plumber	E1/4	61B	1	7th Trans Grp Ft Eustis, VA
Water Craft Engineer	E1/4	61C	1	
TOTAL			15	

TABLE 5-41 - ROWPU PERSONNEL RECOMMENDED

Description	Grade	MOS	REQ
Bargemaster	E-7	51N40	1
Shift Leader	E-6	51N30	1
Shift Leader	E-5	51N20	1
Marine Engineman	E-5	61C20	1
Marine Engineman	E-4	61C10	1
Deck Hand	E-4	61B10	1
Deck Hand	E-3	61B10	1
Pwr Gen Equip Rprmn	E-4	62B10	1
Water Purif Spec	E-4	51N10	2
Water Purif Spec	E-3	51N10	2
Electrician	E-4	51R10	1
TOTAL			13

Equipment. The ROWPU barge system was newly developed and had many problems that should have been worked out in developmental tests prior to the JLOTS II operational testing. This was not possible due to time constraints however, and the system therefore did not operate well. The manuals for the barge systems in general were incomplete. The ROWPU manual provided was for a land-based unit which is considerably different from the barge mounted unit.

The chlorination system was operated for the first time during JLOTS II. The crew was not well trained and several breakdowns occurred.

Insufficient spare parts were provided for maintenance/repair and those on hand were not cataloged or stored properly so were hard to find.

A large number of additional equipment deficiencies were identified and corrections/improvements were recommended by the Army's Independent Evaluation Team from the QM School. These are presented and discussed in Reference 11.

Procedures. During 24-hr operations, the tw ROWPU's stopped only for preventative or corrective maintenance. Water can be produced by the 2 ROWPU's at a rate of about 250 gal per min (gpm) while each of the two

pumps can transfer water to shore at a rate of 350 gpm. The transfer pumps can therefore alternate operations with one being maintained while the other operates. If desired, both can be shut down and the water sent to the 15,000 gal on board storage tanks. The pumps can then pump out the tanks after being restarted.

The ROWPU's had to be stopped several times to change clogged filters which greatly reduced their overall production rate. A bypass filter is recommended to allow changing filters without stopping the ROWPU.

Environment. Production of water and pumping it to shore was not affected by the environment during JLOTS II. Sea States ranged from 0 to 2 during the demonstration. Rougher seas may have affected operations or the crew's ability to maintain or repair the system due to the barges tendency to roll severely.

Conclusions. The production rate demonstrated by the system during JLOTS II was 228,000 gpd which is well below the projected 300,000 gpd. Until the system is modified and retested, a planning rate of 225,000 gpd is recommended.

5.2.3.2 TMT

The portions of the TMT demonstrated during JLOTS II are discussed separately below.

5.2.3.2.1 Six-Inch Floating Hoseline

General. The tanker was delayed in mooring at the floating hoseline due to anchor and environmental problems. These are discussed in Section 5.2.3.2.4. This delay forced a change in the operational plan and resulted in only 150,000 gal of water being pumped to shore.

Time. Table 5-42 provides a summary of the times required to perform the major tasks in the operation and retrieval of the floating hoseline.

Manpower. Personnel from the 549th QM Company cooperated with the tanker crew to attach the floating hoseline and pump water ashore. The personnel were transported to/from the tanker by a LARC-V from the 10th Transportation Battalion.

TABLE 5-42 - OPERATION AND RETRIEVAL TIMES

Start Time	End Time	Event
1055	1105	Tanker drops line for hoisting floating hoseline and hoists hoseline to manifold.
1105	1135	Tanker crew and 549th personnel attach hose to manifold.
1135	1152	MV Sea Drift notifies 549th product control that they are ready to start pumping operation.
1152	1615	Tanker starts pump but has to discontinue due to a leak in flange at ship's manifold. Flange gasket replaced.
1615	1626	549th product control notified by JLOTS Operations to resume pumping operations
1626	1954	150,000 gal pumped, tanker stops pumping.
2120	2125	Shore pump is used to draw water from hoseline.
2242	2328	Hoseline disconnected from tanker and cleared with air.

Equipment. The floating hoseline was in poor condition and it was believed, because of environmental restrictions, that if petroleum was actually being used, no pumping could have been done until the hoseline had been retrieved, repaired, and reinstalled.

The connection of the hoseline to the tankers manifold had a serious leak due to a failed flange gasket. A delay of about 4 hr occurred to replace the gasket and resume pumping.

Once pumping commenced, the pressure was gradually increased from 20 up to 95 psi. This corresponded to a flow rate of 900 gpm which is well in excess of the requirement of 500-700 gpm.

The hoseline marker lights had failed following installation, which made it a hazard to navigation at night. The JLOTS Directorate therefore directed the 497th Engineer Company to recover the hoseline as soon as possible. This was begun on 7 October with a hose reel on an LCU. After

1500 ft had been recovered, the hosereel drive shaft broke. The remaining 2200 ft of hoseline were recovered to the beach.

Procedure. Communications and direction from the product control center on the beach to the tanker were very poor and some operations were delayed until the JLOTS Directorate provided instructions.

The preparation for this demonstration was poor with no spare parts on hand for repair of the hoseline. This delayed the pumping when the flange gasket had to be replaced at the ship's manifold. Repair of the leaks present along the hoseline was not attempted because of a lack of parts.

The retrieval of the hoseline by the hose reel on an LCU worked very well until the hose reel shaft broke. The seaward end of the hoseline was then pulled to the beach by a LARC-V, and two bulldozers dragged the hoseline ashore. The anchors were disconnected from the hoseline by divers who simply cut the connecting lines. Most of the anchors were lost because the divers did not attach buoys to the anchor lines. Some anchors were not cut loose and were dragged ashore with the hoseline. The procedure of dragging the hoseline ashore resulted in damaging it by excessive stretching.

Environmental. No environmental delays were encountered during pumping operations. Retrieval of the hoseline was delayed from 6 October to 7 October due to Sea State 3 conditions which the 10th Transportation Battalion considered too rough for operating the hosereel on an LCU.

5.2.3.2.2 Six-Inch Bottom-Lay Pipeline

The bottom-lay pipeline was not used to pump water ashore. This was due to the failure of the MLMS anchors, failure to correctly install the TMT drag anchors at the pipeline, and damage to the riser hose by a LARC-LX. The submerged pipeline was recovered without any problems.

5.2.3.2.3 TMT Drag Anchors

General. Two drag anchors were used in conjunction with the tanker's bow anchors to moor the tanker in a four-point moor at the floating hoseline. The other two drag anchors had been installed at the MLMS/submerged pipeline site and were never used.

TABLE 5-43 - TANKER MOORINGS WITH TMT DRAG ANCHORS

Date	Start Time	End Time	Event
3 Oct	1230		Meeting between tanker captain and 549th. Captain refuses to try mooring at floating hoseline due to environmental conditions.
4 Oct	1713	1910	Tanker attempts to moor at submerged pipeline but cannot because drag anchor is out of position.
5 Oct	0950		Tanker starts mooring at floating hoseline.
	0955		Tanker drops port bow anchor
	1005		Tanker drops stbd bow anchor.
	1010		Tanker lowers port stern mooring line to LARC-V.
	1020		Mooring line tied to port stern drag anchor.
	1030		Tanker lowers stbd stern mooring line to LARC-V.
	1040		Mooring line tied to stbd stern drag anchor. (See Table 5-42 for pumping times.)

Time. Table 5-43 lists the major event related to use of the drag anchors. The tanker was moored at the floating hoseline anchors in less than one hr.

Manpower. The 497th Engineer Company was responsible for installing, maintaining, and recovering the drag anchors while the 549th Quartermaster Company was responsible for the operations with the tanker. This split of responsibility was not handled well and resulted in confusion as to who was to set the anchors and assist the tanker while mooring. There was a definite need for control/direction by the operational commander.

Equipment. The tanker stern mooring lines were pulled and attached to the TMT drag anchors by a LARC-V. The nylon lines were heavy and did not float which made them very difficult to handle when connecting to the anchor buoys. Floating lines are recommended since they are easier to handle.

A TCDF was used to move the anchor that was out of place at the MLMS site. While attempting to set the anchor, the anchor chain broke. Preparations were made to replace this anchor but retrieval of the floating hoseline took priority and the installation of the replacement was cancelled.

Procedures. Organization and coordination of the efforts to moor the tanker were generally poor with little communication between the 497th Engineer Company, the 549th Quartermaster Company, and the tanker's captain.

Environment. The tanker captain refused to attempt to moor at the floating hoseline on 3 October because of the relative positioning of the anchors, the hoseline, and prevailing wind and current. Figure 5-43 shows the conditions at that time, which would have forced the tanker to try to make the mooring with his stern to the wind and current.

5.2.3.2.4 TMT Onshore Storage and Delivery System

Offloading difficulties greatly reduced the amount of water handled by the TMT onshore system from an original estimate of 3 million gal to only 320,000 gal.

Beachside operations were conducted by the 549th Quartermaster Company with the 109th Quartermaster Company located across base to control the final storage of the water. During the limited operation it was noted that the product control section was not always in control of the pumping operation during receipt of water and pumping orders were not transmitted in a timely manner.

The only equipment problems of consequence occurred when the diesel generator powering communications at the product control center was refueled with mogas which shut it down. This interupted the normal communications channels until a backup generator was provided. Since communication can be critical during pumping of fuel, a backup generator should always be on hand.

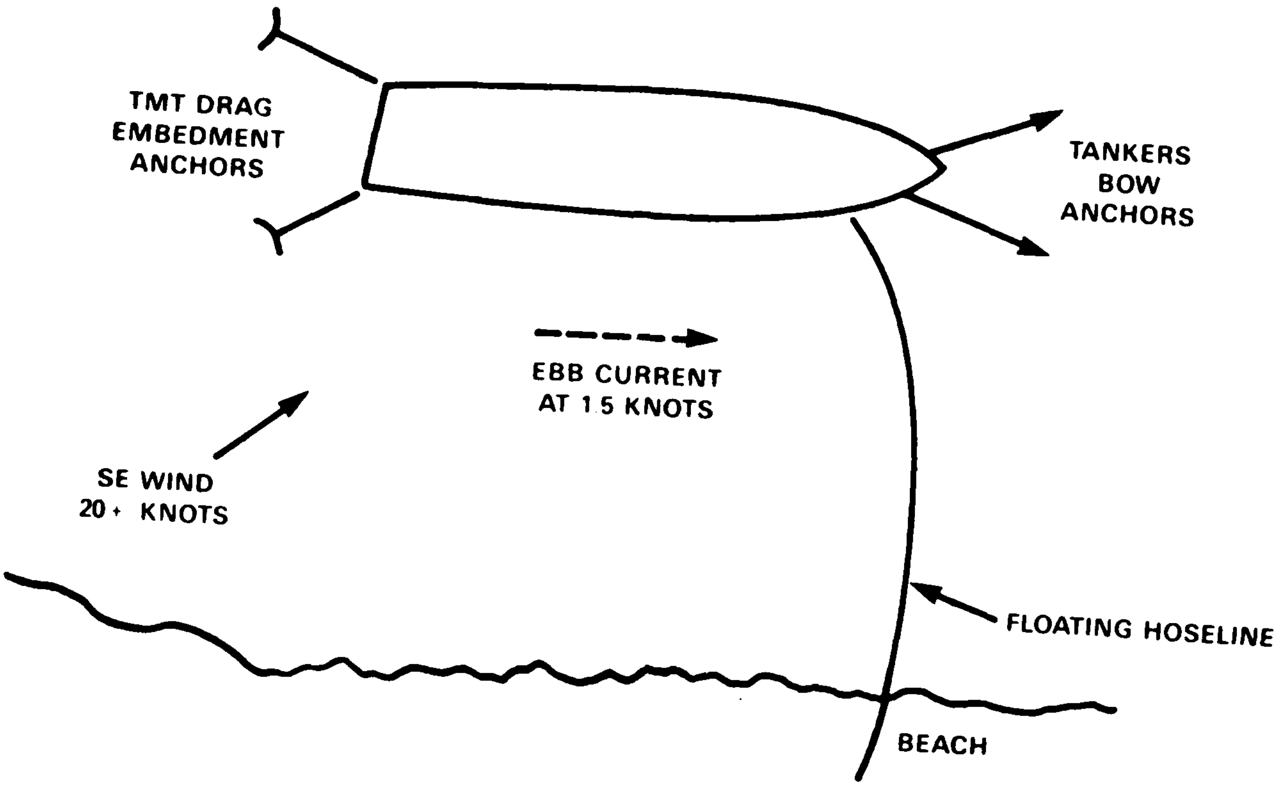

Figure 5-43 - Conditions at the Floating Hoseline Anchorage on 3 October 1984

A split did occur in a hose onshore during pumping but the system was set up so that a section of hose could be bypassed and replaced without stopping pumping.

5.2.3.2.5 Bulk Fuel Tank Assembly (BFTA)

General. Operations consisted of the BFTA's being interconnected and then connected to the 50,000 gal bladders. Approximately 178,500 gal of water was pumped into BFTA-1. Fill/discharge cycles between the BFTA's were conducted a total of four times. Water was stored in BFTA-1 for a total period of 37 hr. The water was then discharged into 50,000 gal bladders for future training use by the host unit. Records were maintained on height of bladders, movement of bladders, pumping times, and total amount of water pumped by taking readings from support equipment (height poles, flow-meters etc).

Time. The BFTA received, stored, and issued water as shown in Table 5-44.

Manpower. Operations were conducted by the same 8-person crew that installed the BFTA's

- The existing training program was found to be adequate to prepare typical user troops (MOS 76W) to effectively operate the BFTA. However, the training program inadequately prepares the typical user to maintain the BFTA. Personnel were capable of performing 90 percent of the operational tasks. However, personnel were capable of performing only 79 percent of the maintenance tasks (based on oral examination).

Equipment

- The BFTA is capable of operating with fuel handling equipment (6-in. flow meter, 600 gpm pump, 6-in. and 2-in. "Y" valves, 6-in. gate valves, 2-in. hose, and 6-in. flexible hose) and with other BFTA's as demonstrated.

- The BFTA provides larger capacity storage tanks thus decreasing the total resources required to perform the mission.

- The BFTA's successfully received, stored, and issued water during operations with no leaks, however, one BFTA did creep 6 in. during fill/ discharge operations (Table 5-44).

Procedures. Standard procedures were used to pump water into and between the BFTA's. No operational difficulties were noted.

BFTA-1 was noted to creep during filling. This was attributed to the 2 percent slope and stretching of this material.

Environment. No environmental effects were noted other than a small amount of creep due to the site slope.

Conclusions. The BFTA appears to have no operational problems and can interface with other BFTA's and standard Army POL equipment.

- Approximately 178,500 gal of water were utilized instead of 210,000 gal of petroleum products. (The specific gravity of petroleum products was assumed to be 0.85 as compared to 1.0 for fresh water). Water was utilized to minimize possible environmental effects in case of durability failure of the test item.

- No leaking or wicking was evident with either of the BFTA assemblies.

- Personnel training was considered adequate for operating but not for maintenance of the BFTA.

TABLE 5-44 - BFTA FILL/DISCHARGE RESULTS

Date	17 Sep	18 Sep	19 Sep	20 Sep	21 Sep	22 Sep
Pumped to	BFTA-1	BFTA-2	BFTA-1	BFTA-2	BFTA-1	50,000 gal Bladders
Discharged from	50,000 gal Bladders	BFTA-1	BFTA-2	BFTA-1	BFTA-2	BFTA-1
Total Time ***	6 hours 59 min****	13 hr 43 min	13 hr 54 min	14 hr 22 min	14 hr 3 min	-
Total Pumped (gallons)	178,520	178,999	178,500	178,568	178,381	**
Total Height (inches)	No reading	72	78	*	76	Not required
Total Storage Time	71,459 gal for 24 hr	-	-		178,381 gal/24 hr	

*No readings taken due to height (safety) poles falling down and inaccurate reading from resetting poles.

**No meter was attached to discharge hose line.

***Total time does not account for the time to discharge from one BFTA to another BFTA. It only accounts for the time to fill the bladder. Multiply fill time by 2 for total usage time of both BFTA's.

****The total pumping time (6 hr and 59 min) on 17 Sep is considerably less than on the other fill/discharge trials because of the close proximity of the pump to the source of water (50,000 gal bladder). The distance increased from 15 meters between pump and 50K bladder to over 180 meters between pump and BFTA.

5.2.3.3 Multi-Leg Mooring System (MLMS) Anchorage

The MLMS anchorage was never used due to the failure of the anchors to pass their pull test, loss of 2 MLDD's, and damage to the riser hose of the bottom laid pipeline.

5.3 CONTROL AND DOCUMENTATION

5.3.1 Command Control

Transition from a Navy/Marine Corps Operation to an Army Operation occurred as mutually agreed upon by the Service Senior Commanders and as approved by the Joint Test Director. It was a single event about halfway through the Throughput Test and was marked by a termination of all Navy operations and a simultaneous commencement of Army LOTS operations. The Navy/Marine Corps Systems were deactivated and withdrawn except for the elevated causeway (ELCAS), and the Army commenced operations with assigned Army units and equipment.

5.3.1.1 Organizational Relationship

The Service Senior Commander during the Army portion of JLOTS II was the Commander, 7th Transportation Group. During test operations, the 7th Transportation Group established a Forward Command Post (CP) at Fort Story, Virginia. From this CP, the 7th Group Commander exercised overall command and control of Army Forces involved in the test. The organizational structure is illustrated in Figure 5-44.

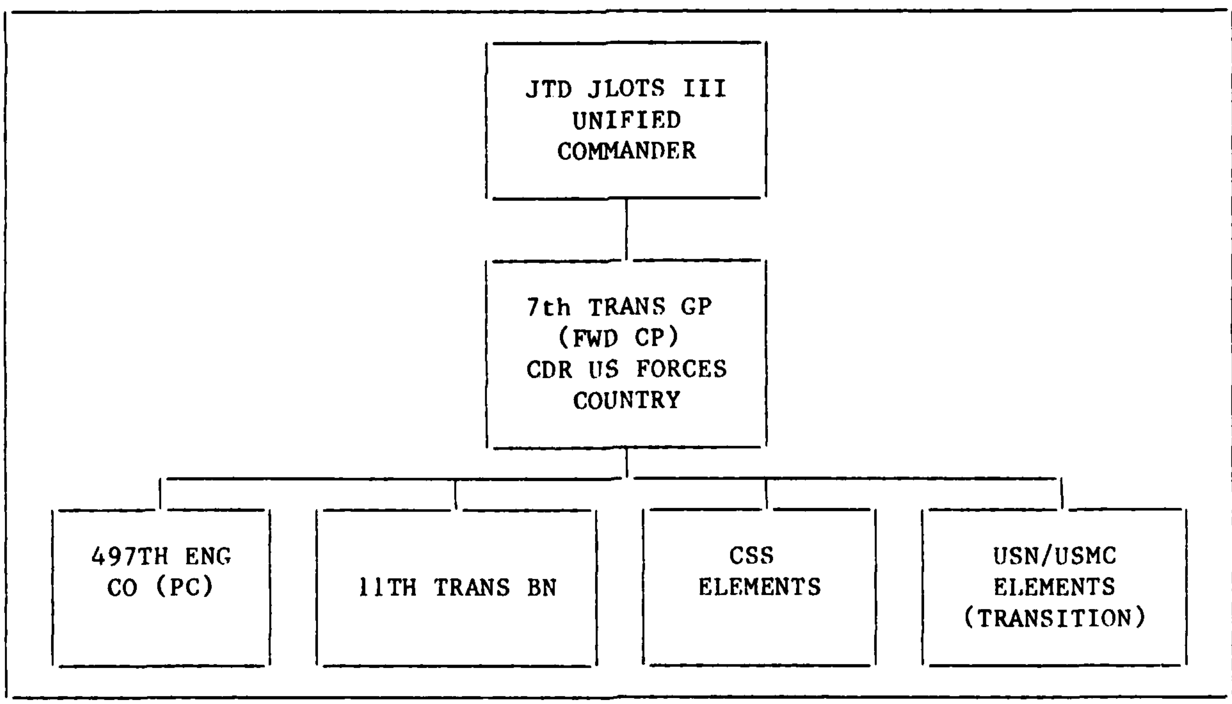

Figure 5-44 - Army Organization

The 11th Transportation Battalion (Terminal Service) exercised operational command/control over all company and detachment sized units committed to the dry cargo portion of the test. All Army units/activities committed in support of JLOTS, but not directly involved in test operations, were coordinated by the 7th Transportation Group Forward CP at Fort Story. The command and organizational relationships in the ROWPU and TPT areas, particularly the Engineer and Quartermasters units, were not well established with the overall command structure.

The test organization did not account for facilities and support such as:

- Field maintenance and repair of equipment, e.g., the LACV-30 and LARC-LX.
- Resources required to install equipment from a deployed configuration, e.g., installation of DeLong caissons and ramps.

The command attention was almost totally diverted from JLOTS II objectives during VIP visits and during the Fast Sealift Support (FSS) ship demonstration which was to have been conducted on a not-to-interfere basis.

Daily operations meetings were scheduled throughout the test period to disseminate command and operational information and to coordinate the action of the organizational elements. On the first day of the FSS ship demonstration (10 October) the JTD JLOTS II was represented by the Data Manager and, the Commander, 7th Transportation Group was represented by an Army Captain from a subordinate organization. Following meetings either had similar representation or were cancelled. From that point on the command structure and organization was not effective in conducting LOTS operations.

5.3.1.2 Lighter Control

During the Army portion of the test, the overall flow of cargo was directed by the Commander, 11th Transportation Battalion through a Clearance and Lighter Control Center (CLCC) operated by the battalion S-3 operations section. This primary CLCC had subordinate elements at the beach, on the T-ACS/containership and the breakbulk ship. Through the use of the two Lighter Control Centers (LCC) aboard the ships, which were subordinate to the CLCC, management and control of lighters in both container and breakbulk cargo flow was accomplished. The CLCC maintained a

status board of all lighters and beach clearance assets to manage resources available to support offload operations. The subordinate LCC's were responsible to insure that lighters were available to each ship (container and breakbulk) in sufficient numbers to safeguard against any break in cargo flow.

Compared to Navy Operations the larger quantity of smaller lighters used by the Army imposed the requirement for increased coordination by the LCC on the T-ACS. The absence of this coordination during the test indicates a need for establishment and implementation of operational procedures. Often the LCC was not aware of what lighters were to be used and did not know the status of lighters that were scheduled as part of the operations. Additionally, when voice communications were ineffective, there appeared to be no backup procedure, such as flags or lights for signaling lighters to the T-ACS mooring stations. Additional training is recommended.

5.3.2 Cargo Documentation

General. The documentation system used during the Army portion of the Throughput Test was a combination of the Automated Cargo Documentation System (ACDS) and, for a limited number of containers, the Logistics Applications of Automated Marking and Reading Symbols (LOGMARS).

The ACDS utilized two data collection techniques. As containers departed the beach for the Marshalling Yard, their serial numbers were hand recorded and, as a demonstration, were entered into hand-held terminals. The hand-held terminals were used exclusively aboard ship to record the departing containers. Container serial numbers were and recorded in the Marshalling Yard along with the container stowage location. Several containers marked with bar code labels were scanned, requiring data takers to physically contact the container. The scanned data was temporarily stored in a hand-held terminal.

Periodically, the ACDS hand recorded data was collected at the remote terminal on the beach or in the Marshalling Yard and transmitted to the computer. The ACDS hand-held terminal aboard ship had to be physically

transferred to the beach once each shift change to be entered into the computer via the remote terminal. There was consequently a 10-hr delay in the early recordings aboard ship.

The LOGMARS hand-held terminal on the beach had to be carried to the computer in the Marshalling Yard and dumped into a compatible terminal for transfer into the computer.

The container serial number, entered into the computer, would link up with all previously entered data on the container, generated when the container was packed, shipped, loaded aboard ship, etc.

Equipment. The computer trailer was equipped with the following items:

- Main Computer
- Card Reader
- Magnetic Tape Reader
- Data Input Terminal
- Two Printers
- Supply of Hard Disc Memory
- Terminal - for hand-held terminal data transfer
- Bar Chart Printer - translates data into bar chart
- Air Conditioning
- Power Protection Unit - filters input power lines

Remote equipment included:

Beach

- Data Input Terminal
- Hand-Held Data Terminals (ACDS)
- Hand-Held Data Terminal and Scanner (LOGMARS)
- Data Forms

Marshalling Yard

- Data Input Terminal
- Hand Held Data Terminal and Scanner (LOGMARS)
- Data Forms

Ship

- Hand Held Data Terminals

Comments

● Shipboard data records had to be physically delivered ashore before entry into the computer. This occurred once per shift (10-hr interval). However, the shipboard data was not as critical as that identifying the container in its stowage positions ashore. This is where it would be accessed by units ashore during the test.

● The remote terminal operators were able to enter data as it was collected from the beach, ship, and Marshalling Yard. However, in a continuing operation, the data load could well exceed single terminal capabilities and might require expanded data input facilities.

● A useful addition to this system is a hand-held terminal data input facility (data dump) located at data collector stations on the beach and hard wired to the main computer. This system exists but was not used.

● An alternative to the data dump would be a radio-linked, hand-held unit which would input data directly to the computer and eliminate all delays.

● The LOGMARS scanning system does not incorporate error identification if the container markings are improperly formatted. This occurred during the test and was discovered only because of the data collector's familiarity with the system.

● The system was observed to keep an accurate accounting of container transfers.

● No capability to interface with the USMC MACTDS was demonstrated when the transition from USMC to US Army occurred.

● The systems used during the subject test are to be replaced by a new system, Department of the Army Standard Port System-Enhanced (DASPS-E).

6.0 MAJOR CONCLUSIONS AND RECOMMENDATIONS

The JLOTS II Test Design established five major objectives for the joint test and evaluation of the Service capability to deliver equipment and supplies to forces ashore operating where port facilities do not exist or are inadequate. The five objectives were expanded into 30 evaluation subobjectives. The Test Design was originally published as a "comment draft" in July 1982. That draft was reviewed by each of the Services and the comments and recommendations forwarded by Service Headquarters to the Joint Test Director (JTD). The comments received were substantive, but the test scope and objectives remained unchanged. The final Test Design[5] thus contains the joint objectives (rephrased for clarity, but unchanged in scope and intent) staffed and approved by the participating Services. The exact statement of these objectives and subobjectives is included in Section 1.3 of this report.

Since this report, the Analysis and Evaluation of JLOTS II Cargo Throughput Operations, is the last major report to be published for the project, the major conclusions and recommendations for all objectives and subobjectives are either included herein, or reference is made to the report where they may be found.

6.1 DEPLOYMENT

Two of the three deployment subobjectives, deployment of selected JLOTS equipment on a LASH ship and on a SEABEE ship, were the subject of the JLOTS II Deployment Phase and are reported in the Deployment Phase report[1].

The third deployment subobjective, deployment of the Offshore Bulk Fuel System (OBFS) on a breakbulk ship, was not conducted. The OBFS, as defined when the JLOTS II Test Design was published, included the Amphibious Assault Fuel Supply Facility (AAFSF) and the Amphibious Tanker Terminal Facility (ATTF). Final development and procurement of the ATTF was terminated prior to JLOTS II testing. Operational planning for deployment of the remaining AAFSF aboard the breakbulk ship was never initiated.

6.2 INSTALLATION AND PREPARATION

The Services' capability to install and prepare over-the-shore systems and equipment is directly related to the complexity of the installation and preparation tasks and the extent of training that personnel in the participating units have received. Also, in the cases of the Elevated Causeway and bulk fuel systems, installation and preparation operations were impeded for lack of well structured command relationships.

Installation of the Navy calm water Roll-On/Roll-Off (RO/RO) ship offloading facility (Subobjectives 2.1 and 2.2) was reported in the JLOTS II RO/RO Phase report[2]. Installation of the Amphibious Tanker Terminal Facility (Subobjective 2.6) was not accomplished because the system was not available.

6.2.1 Preparation of T-ACS

Conclusions

- The T-ACS can be prepared for operations in approximately 10 hr. During the test it was accomplished quickly and efficiently by the T-ACS civilian crew.
- The T-ACS self-offload of LCM-8's and causeway sections is deficient. The Causeway Section, Powered (CSP) could not be lifted as its weight exceeded the 95-ton tandem crane lift capacity. Also, the Crane/Rider Block Tagline System was not able to control load pendulations when ground swells cause even slight T-ACS rolling of as little as 1 deg. As such, lighterage offload was not demonstrated in other than calm seas where there is no T-ACS roll.
- A containership can be moored to the T-ACS in 2-hr by using commercial tugs.

Recommendations

- The T-ACS cranes should be redesigned to provide for the lift of a Side-Loadable Warping Tug (SLWT) plus a 10 percent weight margin. Also, load indicators should be added to the cranes.
- The T-ACS Rider Block Tagline System (RBTS) should be redesigned so that it can effectively control load pendulation when offloading lighterage.
- Cleats for hand taglines should be strategically located on T-ACS.

- The T-ACS mooring fender attachments should be redesigned to eliminate padeye failures and wire rope chafing.

- Additional chocks, mooring bitts, and a capstan near the T-ACS mid-body should be added to enable the use of longer and additional spring lines to suit different types and sizes of containerships.

- The overhang of the T-ACS bridge wings and other variations in hull configurations should be investigated and interference problems should be eliminated.

- Mooring demonstrations should be conducted without the use of tugs.

6.2.2 Installation of ELCAS

Conclusions

- The installation of the ELCAS went very poorly. A total of 7 days were required, not including the days lost for bad weather. This exceeded the times predicted for installation.

- The total task of ELCAS installation and preparation cannot be properly evaluated since much of the ELCAS equipment was administratively delivered to the site.

- Multiple failures of the hydraulic cranes (resulting in the use of a rental 60-ton crane) may be an indicator that hydralic cranes are not suitable for this environment, or that the Amphibious Construction Battalion does not have adequate field repair capability for the cranes.

- Personnel quantity was adequate. Training was deficient for pile pinning, pierhead side connecting and container crane installation. There was a lack of teamwork during the installation between crews from different organizations.

- Crane operations, especially pile placement and driving, were limited to Sea State 2 due to the motion of the causeway sections.

- Pile driving was greatly extended due to the presence of soft subsurface materials.

Recommendations

- Planning for ELCAS installation should allow 5 to 7 days, excluding weather days, until better times are demonstrated in future installations of the complete ELCAS.

- Training should be performed where all of the equipment and support is operationally brought to the beach site.

- The use and maintenance/repair of hydraulic cranes in this environment should be reevaluated.

- Equipment should be developed to permit crane operations on floating causeways in conditions up to and including Sea State 3 and winds up to 30 mph.

- Training should be regularly performed for installation around the clock and should include all of the ELCAS equipment including the container crane and safety system.

- Training should include personnel from Naval Reserve units. Teamwork should be stressed.

- A subsurface beach survey should be developed/used to assist in determining the location of the ELCAS to avoid soft-bottom problems and a spread footing should be developed to reduce pile driving requirements when soft bottom is encountered.

6.2.3 Preparation of TCDF

Conclusions

- The use of two Army tugs was adequate for mooring the TCDF to the SS EXPORT LEADER. The Sea State 2 mooring of the TCDF was accomplished in 14 min from the time the first line was passed.

- The truck tire fendering system used on TCDF-BPL 6702 was inadequate.

Recommendations

- A fendering scheme should be developed and employed that would eliminate the hard structure contact between the TCDF and the containership.

6.2.4 Installation of DeLong Pier

Conclusions

- A deficiency exists in the current capability to install a DeLong Pier because no equipment is identified for installing caissons in the pier jacks/wells.

- LCM-8's are marginally adequate to position DeLong units at the beach.

- After a DeLong Pier is positioned, it can be elevated in approximately 1 hr.

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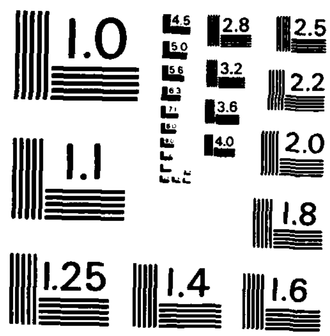

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- Original planning and procedures for installing and supporting the DeLong ramp were not successful.

- The use of RTCH tires for lighter fendering at the DeLong Pier evolved during the test and appeared to work well.

Recommendations

- If the DeLong Piers are to be used in LOTS operations, plans should be developed to:

  - Set forth installation procedures (installing caissons, deploying ramp)
  - Establish equipment inventories (e.g., fenders)
  - Specify deployment of required support equipment (crane and RTFL on beach)
  - Delineate operating procedures (truck maneuvers, use of RTCH)

- B-DeLong beaching should be planned for periods of high tide and low tidal current to minimize powering/control difficulties and beach the pier as high as possible to reduce the incidence of abutment erosion.

6.2.5 Preparation of Beach and Marshalling Areas

Conclusions

- The installation of the roadway system in JLOTS II was not a demonstration of operational Army capability to prepare a beach. Most of the support equipment was owned and operated by Fort Story, Virginia Public Works. Army personnel were untrained and manuals were not available for Sand Grid roadway installation.

- Sand Grid roadways deteriorate rapidly when subjected to tandem axle vehicles making short radius turns.

- The truck loading mats for the RTCH, LACH, and Amphibian Discharge Sites were developed by laying MOMAT adjacent to and overlapping the Sand Grid roadway in the respective areas. This installation was satisfactory both with respect to offload operations and to the capability for shifting the mats to other locations, if required.

- The transition from Sand Grid to the ELCAS and the DeLong Pier was MOMAT which overlaid the Sand Grid at the interface. This installation performed satisfactorily.

Recommendations

- A future test should provide an opportunity to evaluate the Services' operational capability to prepare beach roadways for container cargo movement in LOTS operations.

- A Service manual should be developed for beach preparation and maintenance. It should include installation procedures, equipment, manpower, and criteria for: vehicle type, turning radii, maintenance and repair procedures, and proper operations procedures (restrictions).

6.2.6 Installation of DASPS

Conclusions. The DASPS-E was not available for JLOTS II. The earlier designed Automated Cargo Documentation System (ACDS) coupled with Logistics Applications of Automated Marking and Reading Symbols (LOGMARS) was used. Installation did not represent DASPS-E installation.

Recommendations. Demonstrate installation of DASPS-E during an operational exercise without utilizing existing phone lines.

6.2.7 Installation of AAFSF

Conclusions

- The two days used to install AAFSF in JLOTS II may be reduced in the future following improvement in procedures and training.

- Installation crew did not include sufficient Boatswain Mate skills and training level was low as might be expected for a prototype system not yet in operational status.

- The 40-lb anchors installed to hold the hoseline were inadequate and allowed the hose to move with the current.

- Communication equipment failures complicated the command and coordination of installation operations.

- Steering casualties in the SLWT's delayed installation operations.

- Sequential rather than concurrent installation procedures delayed the completion.

Recommendations

- Communications equipment should be improved to reflect current state-of-the-art capability and reliability.

• 150- to 200-lb anchors should be used to hold the hose in strong crosscurrents.

• Training of personnel should be increased and should include daily planning sessions.

• The crew should be formed from a single unit and should include more personnel trained for boat handling.

• Equipment and procedures should be developed for a capability to install the AAFSF in Sea State 3 conditions.

6.2.8 Installation of AAFS

Conclusions

• Installation of one module of the AAFS (one sixth of a complete AAFS) can be installed in 14 hr.

• Installation crew size of 12 is adequate. Training level was good.

• Failure of a front-end loader during installation may indicate a need to review availability/maintenance of support equipment.

• AAFS installation on the beach in an area later flooded by high tide may indicate a need to review installation plans and procedures.

Recommendations

• The AAFS should be installed back from the beach above the storm tide level.

6.2.9 Installation of TMT and MLMS (Six-Inch Floating Hoseline, Six-inch Bottom-Lay Pipeline, Drag Anchors, TPT and MLMS)

Conclusions

• The Army did not display a capability to install an operational POL system.

• The overall condition of the TMT equipment was poor. Equipment was not in satisfactory operating condition after installation.

• Personnel were not trained to handle the rough weather or strong currents experienced.

• The exception to the above was the TPT a basic module of which was installed in 3.2 hr by a well organized crew. Sand contamination and no protection of hoses at road crossing marred installations.

- The floating hose was installed in 1.2 hr. However, the technique used is considered risky for conditions other than calm water and slack current.

- The 40-lb anchors used to hold the floating hose were inadequate considering the currents at this site.

- The lighting system used to mark the floating hoseline was inadequate, and the hoseline was considered a hazard to navigation at night.

- Installation of the bottom-lay pipeline went well. Beach preparation, pipe assembly, and installation was accomplished in 31.7 active hours during a three-day period. A pressure test was not conducted until directed by the JTD, however.

- Installation of the drag anchors presented no problems except that they were not 'set' at the time of installation and one was installed out of position

- Coordination between the crew installing the drag anchors and the tankers captain was very poor.

- The MLMS anchors were installed using a military crew under direction of R&D personnel. A total of 5 anchors were successfully deployed. Two failed pull tests and two of the MLDD's were separated from their anchors by unknown causes.

- Installation of the MLMS anchors is limited to daylight and appears to be limited to Sea State 2 or less since personnel must climb onto the MLDD to install the anchor.

Recommendations

- The floating hoseline, bottom-lay pipeline, and drag anchors need to be upgraded, refurbished or, replaced.

- Personnel training should be performed under conditions including strong currents and rough waters. Training should totally simulate the use of fuel and not allow shortcuts because water is pumped.

- Coordination among all units involved in POL installation and operations is necessary and should be practiced, including involvement of the tanker personnel.

- Pressure testing of the pipeline and hoseline, setting anchors, and generally checking the system should be performed immediately after

installation while the installation assets are still available in case repairs are needed.

- Repair of installed equipment should be practiced.
- Equipment and procedures should be developed for a capability to install the systems in Sea State 3 conditions.

6.3 CARGO THROUGHPUT

The over-the-shore systems and equipment capabilities for sustained container, breakbulk, vehicle, and bulk POL systems operations were never really tested. The longest continuous cargo offloading sequence occurred during the Navy/Marine Corps portion of the Throughput Test where operations continued from 0800, 20 September to 1800, 24 September. This was the first container offload cycle, and it involved many personnel assignment and training, equipment, and procedure changes and adjustments as should be expected at the beginning of a test. The Elevated Causeway, a major element in the current Navy/Marine Corps system, was not available for use during Navy/Marine Corps offload operations. Subsequent offload cycles during the Army portion of the test were shorter cycles within which selected equipments such as lighter types were chosen for brief periods of emphasis. None of these periods could be considered to constitute "sustained" operations.

One of the broad, overall goals of JLOTS II was to determine the productivity of offload systems when operating in Sea State 3. Much attention was given to choosing a test location and time to optimize the chance of experiencing Sea State 3. This latter endeavor was successful, and Sea State 3 was experienced approximately one-third of the available test time. The finding from this experience is that a sustainable, productive Sea State 3 capability does not exist. The primary limiting element is the lighterage. Other factors also apply and are enumerated in the conclusions that follow.

The capability of the RO/RO offloading facility to discharge vehicle cargo from RO/RO ships (Subobjectives 3.1 and 3.2) was reported in the RO/RO phase report[2]. The joint operation of Services' systems and equipment to conduct sustained breakbulk and container cargo throughput (Subobjective 3.7) was not included in the operational plan prepared for

the test. The discharge of cargo from LASH barges (Subobjective 3.8) was originally intended to be appended to the Deployment Test. The Deployment Test schedule slipped approximately one year and, as a result, the military units and equipment required for the LASH barge test were not available.

Numerical, planning factor, and cargo throughput projections are not provided in this conclusions section of the report, but rather are included in a separate, Planning Factors section (Section 7).

6.3.1 T-ACS Capability in Sea State 0-3

Conclusions

- The anchoring system on the T-ACS was adequate to hold both vessels without incident. However, since a single anchor was used, the vessels swung with the tide changes, and the T-ACS lighterage mooring stations were on the windward side half of the time. Numerous test delays occurred because conditions were too rough for lighters on the windward side to operate.

- The 10-ft diameter ship-to-ship alongside fenders performed adequately but provided barely adequate ship separation for the T-ACS and EXPORT LEADER. Larger containerships (greater freeboard) are not compatible with the T-ACS with only 10-ft fenders because the rider block outriggers will hit the side of these containerships.

- During three separate 10-hr operating periods T-ACS achieved container transfer rates exceeding 300 per 20-hr day while using five crane booms concurrently in calm sea conditions.

- Container offload operations can be safely and efficiently conducted in Sea State 2 and below as long as prevailing ground swells do not cause the T-ACS to roll. Once the T-ACS starts to roll, even as little as 1 deg, crane operations could not be conducted, because the T-ACS crane/RBTS was ineffective in controlling container pendulation.

- The hydraulic automatic container spreader bars were too heavy to control with taglines and were prone to breakdown. These overly complex devices are unsuitable for offshore applications. Manual spreaders and container slings replaced the automatic spreaders and were effective.

- The method of crewing cranes on the T-ACS during JLOTS II did not produce trained, experienced operators. The turnover of personnel and lack of expertise had a direct and adverse effect on crane efficiency.

- Personnel transfer to and from the T-ACS in rough seas was dangerous and in some cases under Sea State 3 conditions was not permitted.

Recommendations:

- The feasibility of using a stern anchor system in conjunction with the current ground tackle should be pursued. If the T-ACS/containership were capable of spread mooring in order to provide a continuous lee to the port side of the T-ACS, major benefits in productivity would be realized.
- The compatability of the T-ACS to large container vessels should be studied to ensure that adequate clearance exists under conditions of ship roll and T-ACS, crane induced, list. T-ACS crane/RBTS modifications to obtain this compatability should be implemented.
- The crane hook assembly and Rider Block Tagline System (RBTS) should be redesigned and the controls integrated into the basic crane control system. These changes would facilitate pendulation control of loads, contribute to higher productivity, and permit operations to continue during periods when prevailing ground swells causes the T-ACS to roll.
- The hydraulic automatic container spreaders should be replaced by manually operated container spreaders and strongback/sling devices.
- Trained operators, military and/or civilian, should be provided for cranes on the T-ACS. The concept of employing AB seamen on these cranes, which represent the critical link to the whole system, should be changed.
- Safe personnel transfer techniques should be developed for application on all offshore ships.
- All of the proposed T-ACS modification, summarized in Section 3.2.1.1.5, should be investigated and implemented on all of the T-ACS vessels.

6.3.2 Cargo Discharge of SEASHEDS

Conclusions

- The cargo discharge of SEASHEDS went smoothly and orderly.

6.3.3 ALS Capability

Conclusions

- The Causeway Ferries, configured in various lengths, were excellent movers of containers. Major advantages are: high capacity, minimal manpower requirements, and relatively low cost.

- Landing Craft, Utility (LCU-1600 Class) were effective in both container and breakbulk cargo operations. Primary advantages were flexibility of the craft and the ability to perform a variety of roles. Limitations are sandbars or, shallow gradient beaches which prevent the LCU from getting to the beach to offload.

- USN/USMC units effectively offloaded the breakbulk ship and moved the entire 2100 STons of palletized cargo ashore without any adverse impact on container throughput operations.

- The use of an Amphibious Squadron Commander and a primary control ship to exercise command and control was effective.

- Neither the T-ACS, Navy lighterage, nor beach facilities demonstrated an adequate capability to operate in Sea State 3 conditions.

- The Navy did not demonstrate a complete AOA maintenance/support capability. Lighterage, as an example, went to Little Creek for repairs and to wait out stormy seas.

- The USS RALEIGH (LPD-1) provided valuable boat haven support, but the ship's small well deck area was not sufficient to maintain/support all Navy lighters involved in the test.

- Operations were cancelled because of safety considerations based on Surf Observations (SUROB) reports. The procedures for developing these reports and the resulting "maximum surf capacity" for each craft is not current, and doesn't consider modern ALS systems such as the ELCAS which eliminates the need for the lighter to move through the surf zone. In many cases the ALS systems could have been operated safely under these Sea State 3 conditions. The overall test objective on evaluating Sea State 3 operations was not achieved.

- The Navy did not conduct offload operations using the ELCAS due to the long installation time. Army use of the ELCAS demonstrated the effective offload of LCU's away from the beach and beyond the surf zone. Difficulties were experienced with mooring due to current/wind forces and the surging of LCU's in building waves. The only truck traffic pattern used was not recommended in the ELCAS manual and restricted container throughput.

- Causeway Ferries operating with RTCH's at the beach are superior to LCU's operating with LACH's, both in container throughput productivity and ability to operate in shallow water conditions (specifically, the Fort Story sandbar at low tide). The larger Causeway Ferries are the most cost effective.

- The CSP power unit is superior to the LCM-6 tender boats for propelling and controlling Causeway Ferries. Their capability of 360-deg thrust control is effective in maintaining stern position when beached and provides superior control to the LCM-6 when coming alongside a ship or pier.

- Low tides and strong tidal currents/winds were the primary environment factors affecting the approach to and departure from the beach. Causeway Ferry coxswains were not trained for operations near the beach in a crosscurrent. Missed approaches and collisions with the ELCAS were results of inexperience under such conditions. Effective crabbing and course keeping were not demonstrated.

- The modular causeway is wider than the conventional causeway section and provides walking space past the ends of transversely loaded 20-ft containers. However, a Causeway Ferry composed totally of modular causeway sections was not tested and, consequently, control characteristics and beaching/debeaching characteristics (especially at low tide) were not tested.

- A lack of discipline <u>or</u> procedure caused some delay in transit. Lighters awaiting a beach slot would drift well away from the beach site instead of queuing in a designated area.

- It is generally not required to use dozers to winch Causeway Ferries onto the beach.

- Cast-off and clearing time of lighters from a beached position varies considerably as the tide changed during the offload. If the tide dropped between mooring and clearing, significant effort was required to work the ferries free. This required dozers pushing on the bow while the coxswain "wagged" the stern sideways to force a slipping action of the hull on the sand. This operation sometimes required two dozers.

<u>Recommendations</u>

- A two-sided pierhead for the ELCAS should be implemented to provide at least one spot for a 'downstream' mooring.

- The ELCAS pierhead should be further from the beach to move the landing craft mooring location beyond the area where waves build prior to breaking in the surf area.

- Two-way truck traffic is recommended for the ELCAS to avoid delays waiting for trucks.

- Causeway Ferries should normally be configured in a P3 mode for maximum container throughput.

- Lighters should be employed on a unit basis or limited to a single type of lighter during a work shift. This provides many advantages over mixed lighter operations.

- The following actions should be undertaken to establish a Sea State 3 capability.

  (1) Implement the proposed T-ACS modification summarized in Section 3.2.1.1.5.

  (2) Establish regular training for T-ACS lighterage and beach systems under adverse sea/weather conditions.

  (3) Develop and implement improved, standardized lighter mooring procedures both at the T-ACS and ELCAS.

  (4) Develop and implement techniques to allow the ELCAS cranes to operate in 20- to 30-knot winds.

- A review and update of the Joint Surf Manual should be done to provide realistic guidelines for the operational commander on when operations should be halted.

Safety Officers should be established in the T-ACS manning plan. These Safety Officers should possess the knowledge to recognize safety violations and have the authority to direct corrective actions.

- Perform frequent training in operating various sizes of Causeway Ferries in crosscurrents/winds. This applies to holding a course and to operations in approaches to and departures from the beach. Perform frequent training in mooring of LCU's to piers in crosscurrent conditions.

- Develop procedures and perform frequent training in line handling required for mooring lighters to piers.

- Evaluate modular causeway design for sufficient strength to endure long term RTCH operations. Test modular Causeway Ferry with CSP in surf, on beach, and underway in rough seas to assess characteristics.

6.3.4 FLS Capability

Conclusions

- The RTCH performance was outstanding. It had no difficulty with soft sand, interfacing with causeways, truck-loading/offloading, or stacking containers in the Marshalling Yards. Maintenance delays were minimal. Marine Corps operators accommodated rapidly.

- The RTCH container-handling rate, during offload of Causeway Ferries, averaged 2.85 min per RTCH cycle. This rate was achieved by using two RTCH's, alternating between picking each container off the causeway and placing it on the truck.

- The LACH was demonstrated as effective for offloading containers from LCU's on the beach.

- The tractor with flatbed trailer used to move containers from the beach to the Marshalling Yards performed adequately. Its space is not used efficiently since it carries only one 20-ft container and its use is relatively manpower intensive since the containers must be secured with chains to the trailer. This truck trailer combination efficiently transported breakbulk pallets since they can fill the entire trailer.

- Breakbulk cargo was offloaded from lighters and moved to the Marshalling Yard with virtually no effect on container throughput. The 6,000 lb forklifts were preferred for offloading the landing craft. Both 6,000 lb and 4,000 lb forklifts performed well in the Marshalling Yards. The 20-ft aisles in the Marshalling Yards were satisfactory.

Recommendations

- Consider fitting Marine Corps trailers with removable container corner fittings with twist locks (or replace with 40-ft trailers).

- Procure RTCH for USMC.

6.3.5 LOTS Capability

Conclusions

- The Army effectively offloaded the breakbulk ships and moved 1363 STons of palletized cargo ashore without any adverse impact on container throughput operations.

- The TCDF did not demonstrate a favorable throughput rate, but operations were constrained by the prevailing Sea State 2 conditions.

• All Army lighter types used in JLOTS II, when managed efficiently, are capable of interfacing with the T-ACS to support container transfer rates greater than 300 per day in calm conditions.

• LACV-30 is most effectively employed when operating as a single lighter type serving all three T-ACS offload positions. Mixed lighter types cause conflicting situations regarding approach and departure zones, fendering requirements, and LACV-30 noise and spray interferences.

• LARC-LX provides a current lighter capability to consistently operate in upper Sea State 2 conditions. All other lighter operations were terminated before LARC-LX including LCU's which, by design, are more sea state capable.

• LCU's have difficulty approaching and mooring to the ELCAS and DeLong Pier under the tidal current and sandbar conditions at Fort Story.

• The 80-ft width of the A-Delong Pier is minimally acceptable for turning yard tractor/trailer combinations.

• The truck roadway pattern used on the ELCAS reduces container productivity of the ELCAS because the movement of vehicles to the loading position is interrupted.

• The Army did not demonstrate a deployed maintenance/support capability. LACV-30's, for example, were serviced and maintained in the established home-base fixed facilities at Fort Story.

• The Sand Grid roadway performs satisfactorily when subjected to only wheeled traffic. Turns and down-hill sections are more susceptible to wear than straight, level sections.

• The command control organization operated by the Army in JLOTS II did not effectively maintain an initiative to accomplish test objectives when disturbed by the presence of VIP visitors and "not-to-interfere" add-on demonstrations.

• Coordination and control of supporting units was not effectively accomplished.

• Lighterage control was not continuously maintained by the organization established. Lighter control personnel were not always aware of what lighters were being provided or the planned operating schedule.

• Training levels in basic seamanship, cargo handling, and safety awareness were below that expected for a planed test operation.

Recommendations

- More training is required in an operational environment, including regular training on T-ACS, lighterage, and beach systems under adverse sea/weather conditions.
- Develop and implement improved, standardized mooring procedures at both the T-ACS and the DeLong Pier.
- Develop and implement techniques to allow the DeLong cranes to operate in 20- to 30-knot winds.
- Review command relationships and procedures for organizations participating in LOTS operations.

6.3.6 Navy/Marine Corps Bulk Fuel Systems

Conclusions

- The AAFSF demonstrated a limited capability to transfer bulk fuel ashore. The goal of 440,000 gal per day is not supported by test results. Throughput was limited by equipment problems, a strong crosscurrent and a lack of lighting for night operations.
- The AAFS area was flooded by high tides, and the bags were retrieved prior to operation. Three U.S. Army 50,000 gal bags were used during operations with no difficulties.

Recommendations

- Revise AAFSF documentation and training to include operations in crosscurrents and to improve maintenance capabilities.
- Develop a lighting system to provide a night operations capability for the AAFSF.
- The 40-lb anchors used should be replaced with 150- or 200-lb anchors and an appropriate anchor handling systems.
- The AAFS should be installed above the predicted storm tide level.

6.3.7 Army Bulk Fuel Systems

Conclusions

- The U.S. Army did not demonstrate an adequate capability to transfer fuel from a tanker to the beach.
- Operation of the TPT on the beach was adequate.
- Overall communication and coordination was poor.

- The floating hoseline was used to transfer water to the beach in spite of leaks which would have prevented the transfer of fuel.
- The 40-lb anchors installed to hold the hoseline in place were inadequate.
- The bottom-lay pipeline was pressure tested successfully but subsequent damage to the riser hose prevented its operational use.
- The 200-ft length of the riser hose is considered inadequate for large commercial tankers.
- The use of drag anchors or the MLMS anchors was not adequately demonstrated.

Recommendations

- The overall condition of the equipment for transfer of bulk liquids from tanker to the beach should be improved.
- Training should include installation and operation of all systems to improve communication and coordination between units and to clarify the command structure.
- Use adequate anchors to hold the floating hoseline under strong tidal currents.
- Increase the length of the bottom-lay pipeline riser hose.

6.4 CARGO MANAGEMENT AND CONTROL

Cargo management and control systems operated in JLOTS II were not representative of the Service intended capability. The Marine Corps manual system, although operated during the test, is considered obsolete in view of the potential of MACTDS. The Army DASPS-E is being fielded, but was not available for JLOTS II. In view of the potential for joint operations or a transition from Marine Corps to Army operations, it is recommended that MACTDS and DASPS-E be capable of direct interface.

6.4.1 Marine Corps Cargo Documentation

Conclusions

- The prototype MACTDS demonstrated a good capability to be fielded and used. It worked extremely well for tracking the progress of and locating containers and the items in the containers. No capability to track movement of breakbulk cargo was demonstrated.

- Data transfer to the computer was done manually with associated delays and errors.
- The Marine Corps manual cargo documentation system worked well for tracking the movement of containers from the beach to their storage location in the yard. Locating containers was hindered by having to manually search the records.
- No capability was demonstrated to interface with the U.S. Army.

Recommendations

- Continue R&D to field MACTDS including a capability to track breakbulk cargo.
- Retain the manual system capability as a backup to MACTDS.
- Develop the capability to exchange data with the U.S. Army automated data system.
- Develop a capability for the data takers to input data directly to the computer via radio link from a hand-held data terminal.

6.4.2 DASPS

Conclusions

- The systems demonstrated, ACDS and LOGMARS, performed well during the exercise. The ACDS data was transmitted from the beach using existing phone lines.
- The LOGMARS unit did not allow entry of an incorrect bar code and the operator had no backup method to identify the containers.
- The LOGMARS unit accumulated the data into memory. The memory was dumped into the computer at the end of a shift which meant up to a 10-hr delay on container movement data.
- No capability to interface with the Marine Corps MACTDS was demonstrated.

Recommendations

- Demonstrate DASPS-E in a JLOTS scenario without using existing phone lines.
- Provide the LOGMARS with a radio-link capability with the main computer to allow immediate entry of data.
- Develop and demonstrate the capability to accept data from the Marine Corps MACTDS system.

6.5 TRANSITION

A phased transition from Navy to Army control, occurring over a four-day period, was envisioned but was not implemented. The shift to a single-event transition resulted because:

- Adverse weather and sea conditions during the intended transition period interrupted cargo handling operations and required command attention to ensure safety of operational personnel and equipment.
- A single-event transition was easier to implement.

7.0 PLANNING FACTORS

Based on the reduced and analyzed data of JLOTS II, projections are made for the amount of equipment and time required to offload a containership and move the containers to a marshalling area ashore. Only active, operational equipment is identified. Stand-by equipment required to assure availability of operational units in the numbers called for, as well as maintenance and support equipment and supplies, are not identified. These must be estimated by the operational planners, based on knowledge of their equipment availability and unit maintenance capability.

7.1 PLANNING FACTOR SCENARIOS

Each planning factor scenario consists of one Auxiliary Crane Ship, in the T-ACS-1 configuration, offloading a nonself-sustaining containership at an offshore anchorage. Containers are offloaded to lighters which proceed to the beach where containers are transferred to trucks which carry containers to a Marshalling Yard where they are unloaded by container handling equipment. The general scenario is illustrated in Table 7-1.

The specific scenarios examined are identified in Table 7-2.

The standard containership used in these scenarios is the C5-S-73b, which includes the SS EXPORT LEADER, the containership used in JLOTS II. Figure 7-1 shows the hatch arrangement of the C5-S-73b and the relative coverage of the T-ACS-1 cranes over these hatches. The standard scenario containership loadout is 928 twenty-ft containers, each of which is weighted light enough that the Causeway Ferry lighters can carry the average number carried in JLOTS II, and LACV-30's can always be loaded with two containers. This loadout is defined in Table 7-3. A variation to the standard loadout was made for repeat runs of the starred scenarios in Table 7-2. The variation loadout is defined in Table 7-4. There are 272 heavier containers stowed in the lower tiers of the containership holds in a plan that does not exceed container stack load limits for the ship class. These heavier 20-ft containers weigh such that a Causeway Ferry carries only four per unpowered Section, and LACV-30 carries only one.

Scenario unloading investigations were conducted on two other ship classes. One was the C6-S-1w, AMERICAN LEADER Class, and the other was the

C9-M-132b, PRESIDENT LINCOLN Class. These ships, as configured for commercial liner service, are optimized for carrying 40-ft containers. For the planning factor scenarios reported herein, it is assumed that the Enhancement Features of the Strategic Sealift Program have been applied to these ships so that they may carry 20-ft containers in all practical container spaces. Figures 7-2 and 7-3 show the hatch arrangements of these ships and the relative coverage of the T-ACS-1 cranes over the hatches. Tables 7-5 and 7-6 define the scenario container loadout for these ships. The scenarios examined were those starred in Table 7-2. Two further scenarios were investigated for comparison with the heavier container load scenarios of the C5-S-73b. These scenarios included a heavier container load on the C9-M-132b (Table 7-7) and were investigated for an all Causeway Ferry and an all LACV-30 lighter fleet. Again, the heavier containers were weighted such that a Causeway Ferry carries only four per unpowered Section, and the LACV-30 carries only one.

TABLE 7-1 - EQUIPMENT COMBINATIONS FOR PLANNING FACTOR SCENARIOS

Containership/ Crane Ship	Lighter Type	Beach Facility/ Handling Equipment	Truck Type	Marshalling Yard Handling Equipment
Containership/ T-ACS-1	Causeway Ferry (Various Lengths)	ELCAS/Crane or Beach/RTCH	40-Ft or 20-Ft	Unspecified Crane, RTCH, or Other
	LCU 1466 or 1600	ELCAS/Crane, DeLong Pier/Crane, or Beach/LACH	Same	Same
	LACV-30	Amphibian Beach/ Crane	Same	Same
	LARC-LX	Amphibian Beach/ Crane	Same	Same
	LCM-8	ELCAS/Crane, DeLong Pier/Crane, or Beach/LACH	Same	Same

TABLE 7-2 - JLOTS II PLANNING FACTOR SCENARIOS

Containership: C5-S-73b					
Run Description		Ship-to-Shore Distance (Miles)			
		1	2	6	10
CWF (P1&P3) (Double Moor at T-ACS)	RTCH Beach	X*	X	X*	X
CWF (P1) (Single Moor at T-ACS)	RTCH Beach	X		X	
CWF (P1&P3) (Single Moor at T-ACS)	RTCH Beach	X			
LCU-1600	2 ELCAS LACH Beach	X	X	X	X
LCU-1600	4 ELCAS	X		X	
LCU-1466	1 DeLong	X		X	
LACV-30	Amphib Area	X*	X	X*	X
LARC-LX	Amphib Area	X			

Standard run is for shipload of light containers as in JLOTS II.

*Repeat for heavy container load on C5-S-73b and for other containerships.

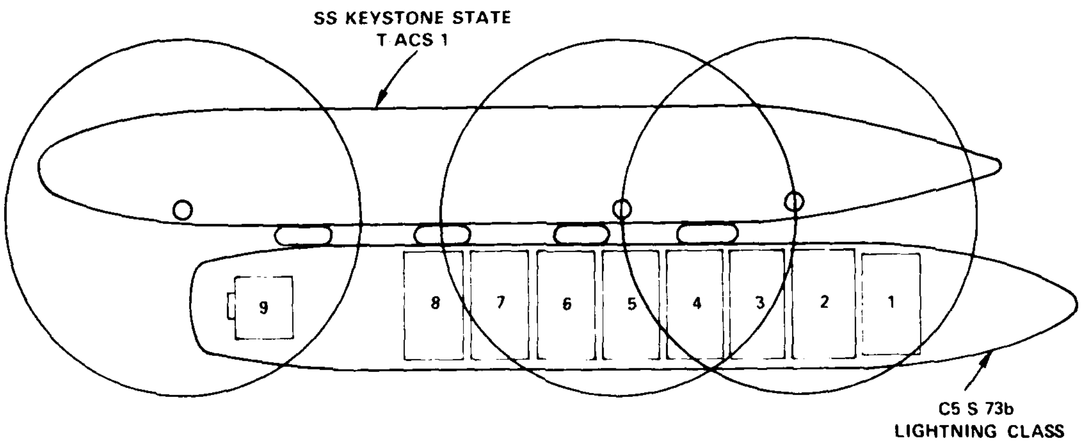

Figure 7-1 - Auxiliary Crane Ship (T-ACS-1) and C5-S-73b Containership

TABLE 7-3 - CONTAINER LOAD PLAN FOR C5-S-73b, LIGHTNING CLASS

Tier No.	Hatch 9	8	7	6	5	4	3	2	1
9									
8	16	18	18	18	18	18	18	18	16
7	16	18	18	18	18	18	18	18	16
Above Deck Total	32	36	36	36	36	36	36	36	32
6	8	14	14	14	14	14	14	14	10
5	8	14	14	14	14	14	14	14	10
4	8	14	14	14	14	14	14	10	6
3		14	14	14	14	14	14	10	6
2		10	14	14	14	14	14	10	6
1		6	10	14	14	14	10	6	2
Below Deck Total	24	72	80	84	84	84	80	64	40

Total Shipload: 928 Twenty-Ft Containers.

TABLE 7-4 - HEAVY CONTAINER LOAD PLAN FOR C5-S-73b, LIGHTNING CLASS

Tier No.	Hatch 9	8	7	6	5	4	3	2	1
9									
8	16	18	18	18	18	18	18	18	16
7	16	18	18	18	18	18	18	18	16
Above Deck Total	32	36	36	36	36	36	36	36	32
6	8	14	14	14	14	14	14	14	10
5	8	14	14	14	14	14	14	14	10
4	8	14	14	14	14	14	14	10	6
3		*14	*14	*14	*14	*14	*14	*10	* 6
2		*10	*14	*14	*14	*14	*14	*10	* 6
1		* 6	*10	*14	*14	*14	*10	* 6	* 2
Below Deck Total	24	72	80	84	84	84	80	64	40

Total Shipload: 928 Twenty-Ft Containers
**Heavy 20-Ft Containers (272 Containers)

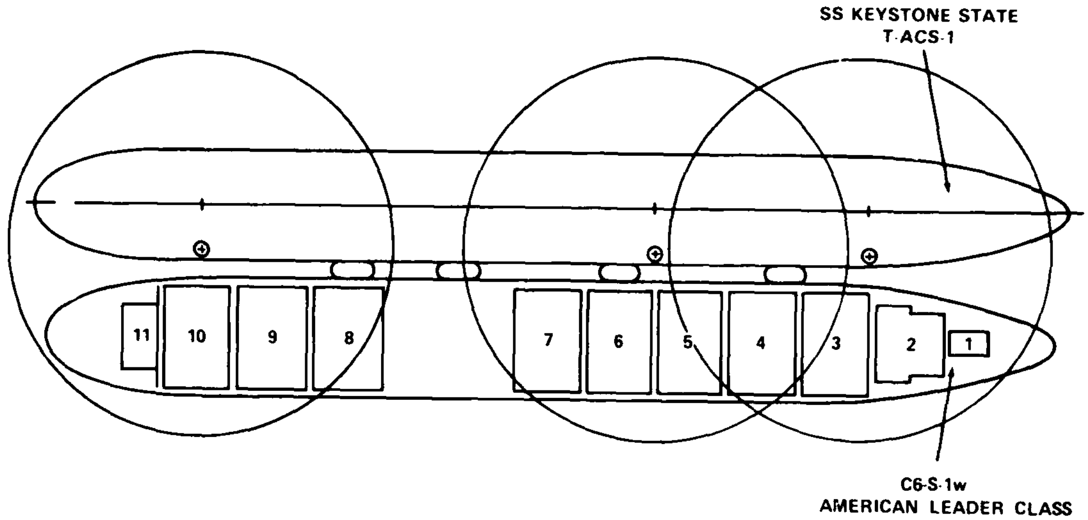

Figure 7-2 - Auxiliary Crane Ship (T-ACS-1)
and C6-S-1w Containership

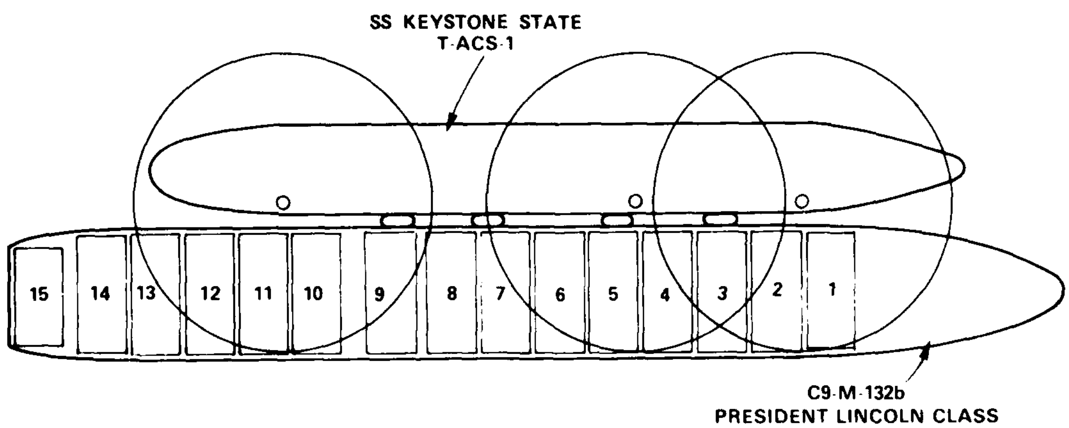

Figure 7-3 - Auxiliary Crane Ship (T-ACS-1)
and C9-M-132b Containership

TABLE 7-5 - CONTAINER LOAD PLAN FOR C6-S-1w, AMERICAN LEADER Class

Tier No.	Hatch										
	11	10	9	8	7	6	5	4	3	2	1
J											
I	14	16	16	12	12	16	16				
H	14	16	16	12	12	16	16	16	16	11	
G	14	16	16	12	12	16	16	16	16	11	2
F	14	16	16	12	12	16	16	16	16	4	2
Above Deck Total	56	64	64	48	48	64	64	48	48	22	0
E	5	12	14	14	14	14	14	12	10	4	
D	3	12	14	14	14	14	14	12	10	4	
C	1	4	10	14	14	14	14	12	6	4	
B		4	10	14	14	14	14	12	6	4	
A			6	8	8	8	14	8	6		
Below Deck Total	9	32	54	64	64	64	70	56	38	20	4
Total Shipload: 1001 Twenty-Ft Containers											

TABLE 7-6 - CONTAINER LOAD PLAN FOR C9-M-132b,
PRESIDENT LINCOLN Class

Tier No.	Hatch														
	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
B															
A	20														
9	20	24	26	26	26	26	26	26	26	26	26	26	26	26	24
8	20	24	26	26	26	26	26	26	26	26	26	26	26	26	24
7	20	24	26	26	26	26	26	26	26	26	26	26	26	26	24
Above Deck Total	80	72	78	78	78	78	78	78	78	78	78	78	78	78	72
6		16	20	20	20	20	20	20	20	20	20	20	20	20	16
5		16	20	20	12	12	20	20	20	20	20	20	20	16	12
4		12	16	20	12		20	20	20	20	20	20	20	16	12
3			12	16			20	20	20	20	20	20	16	12	8
2				8			20	20	20	20	20	16	16	12	8
1							20	20	20	20	20	16	16	8	4
0							16	16	16	16	16	12	8	4	4
Below Deck Total		44	68	84	44	32	136	136	136	136	136	124	112	88	64
Total Shipload: 2500 Twenty-Ft Containers															

TABLE 7-7 - HEAVY CONTAINER LOAD PLAN FOR C9-M-132b, PRESIDENT LINCOLN CLass

Tier No.	Hatch 15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
B															
A	20														
9	20	24	26	26	26	26	26	26	26	26	26	26	26	26	24
8	20	24	26	26	26	26	26	26	26	26	26	26	26	26	24
7	20	24	26	26	26	26	26	26	26	26	26	26	26	26	24
Above Deck Total	80	72	78	78	78	78	78	78	78	78	78	78	78	78	72
6		16	20	20	20	20	20	20	20	20	20	20	20	20	16
5		16	20	20	12	12	20	20	20	20	20	20	20	16	12
4		12	16	20	12		20	20	20	20	20	20	20	16	12
3			*12	*16			*20	*20	*20	*20	*20	*20	*16	*12	*8
2				*8			*20	*20	*20	*20	*20	*16	*16	*12	*8
1							*20	*20	*20	*20	*20	*16	*16	*8	*4
0							*16	*16	*16	*16	*16	*12	*8	*4	*4
Below Deck Total		44	68	84	44	32	136	136	136	136	136	124	112	88	64

Total Shipload: 2500 Containers
*Heavy Twenty-foot Containers (592 containers)

7.2 EXPECTED PERFORMANCE

Sections 3 and 5 of this report covered the analysis of data for each segment of the containership to shore movement. The results of that analysis included values of time required to perform each of those segments. Each of the times has been reviewed by experts to verify that they are reasonable and that they allow for normal operational contingencies. Where the times were judged not reasonable, they were subjected to further examination and, in some cases, the expected performance values presented in this Section reflect a judgemental adjustment. As the expected performance values are presented in the following paragraphs, those cases of judgemental adjustment will be clearly identified.

7.2.1 Lighter Maneuvering at T-ACS

The events of "Approach and Moor" and "Cast-Off and Clear" are presented in Table 7-8.

TABLE 7-8 - LIGHTER MANEUVERING TIMES AT T-ACS

Lighter	Approach and Moor (min)	Cast-Off and Clear (min)
LCU 1600	9	5
P1	10	8
P2	10	14
P3	10	18
F5/6	11	11
LCU 1466	6	5
LARC	5	4
LACV	5	4

7.2.2 Container Transfer Time by T-ACS

The analysis of container transfer times by T-ACS cranes to the various lighter types identified that the effective time per container depends on whether one or two crane booms are in operation at each lighter loading station. There was no effective difference in the rate between stations. Table 7-9 presents the expected performance transfer times.

TABLE 7-9 - T-ACS CONTAINER TRANSFER TIMES

Lighter	Container Transfer Time Per Container Per Boom	
	Two Boom Ops (min)	One Boom Ops (min)
LCU 1600	12	9
P1	16	12
P2	16	12
P3	16	12
F5/6	16	12
LCU 1466	12	9
LARC	6	6
LACV	9	7

7.2.3 Lighter Transit Times

Lighter transit time was an event which produced questionable data. The analysis includes a discussion of the vast data spread and offers a rationale for judgemental adjustment. The expected performance times presented in Table 7-10 include that adjustment for the 1-mile transit distance (the JLOTS II ship standoff distance) for Causeway Ferry lighters. The transit times for 2-, 6-, and 10-mile distances are derived by adding

to the 1-mile time an amount calculated from the expected effective operating speed of a loaded lighter in calm water. There is no apparent difference in transit times for loaded and empty lighters.

TABLE 7-10 - LIGHTER TRANSIT TIMES

Lighter	Transit Time (min)			
	1 Mile	2 Miles	6 Miles	10 Miles
LCU-1600	20	28	58	88
P1	22	31	65	99
P2	24	34	74	114
P3	26	36	76	116
F5/6	28	-	-	-
LCU-1466	20	30	70	110
LARC	15	25	65	105
LACV	8	10	18	26

7.2.4 Lighter Maneuvering at the Beach

Lighters arriving at the beach may be discharged at facilities with appropriately interfacing capabilities. The lighter maneuvering events include "Approach and Moor" and "Cast-Off and Clear". In the cases of lighters arriving at the RTCH, LACH, and Amphibian Discharge Sites, "*Approach and Moor*" *was not an event* because "Transit" continued to the container unloading location. For the RTCH and LACH Sites there was, however, a short period of time used to prepare for offloading that followed "Transit". Table 7-11 contains the lighter maneuvering times at the beach. The cast-off and clear times for P2 and P3 appear higher than expected, but as discussed in Section 3.2.1.3.2.3 there is no clear justification to reduce the values.

TABLE 7-11 - LIGHTER MANEUVERING TIMES AT BEACH FACILITIES

Facility Lighter	DeLong		ELCAS		RTCH Beach		LACH Beach		Amphibian Disc.Site	
	A/M	C/C	A/M	C/C	A/M*	C/C	A/M*	C/C	A/M*	C/C
LCU-1600	4	4	4	3			5	7		
P1					3	17				
P2					4	40				
P3					5	40				
F5/6					5	47				
LCU-1466	4	10	4	4						
LARC									0	1
LACV									0	2

A/M - Approach and Moor / C/C - Cast-off and Clear / Times in minutes
*At these Sites, A/M times are to "Prepare for Offload".

7.2.5 Container Transfer Time at the Beach

Containers are transferred from a lighter to beach clearance vehicles by the handling equipment operating at the particular site. The DeLong Pier, the ELCAS, and the Amphibian Discharge Site used 140-ton cranes. One crane operates at each lighter berth. Two RTCH's operate as a team to unload Causeway Ferries at each berth of the RTCH Site. Similarly, two LACH's operate at each berth of the LACH Site. Table 7-12 presents the time required to transfer a container from a lighter to a beach clearance vehicle (truck) at a lighter berth. During JLOTS II testing, containers were double handled at the Amphibian Discharge Site. The crane placed containers on the beach, and they were subsequently loaded on trucks by RTCH's. The added step did not change the overall effective transfer rate.

TABLE 7-12 - CONTAINER TRANSFER TIME AT BEACH FACILITIES

Facility Lighter	DeLong	ELCAS	RTCH Beach	LACH Beach	Amphibian Disc.Site
LCU-1600	6	9		9	
P1			3		
P2			3		
P3			3		
F5/6			3		
LCU-1466	8	9			
LARC					3
LACV					3

Times in minutes.

7.2.6 Truck Transit Time

Expected performance times for truck transit include time to secure the container load on the truck, to exit the beach area including brief stops for cargo documentation functions, and to travel approximately one mile to the Marshalling Yard. Table 7-13 lists the expected times. If the transit distance is longer, additional time should be calculated at 10 miles per hour unless road and vehicle conditions are known to permit higher speeds, or require lower speed.

TABLE 7-13 - TRUCK TRANSIT TIME

Truck Type	Transit Type (min)
USMC 20-Ft	10
Army 40-Ft	14

7.2.7 Container Transfer Time in Marshalling Yard

Trucks arriving in the Marshalling Yard were generally unloaded by RTCH's. The expected time per container to unload trucks is given in Table 7-14.

TABLE 7-14 - CONTAINER TRANSFER RATE IN MARSHALLING YARD

Truck Type	Minutes Per Container	
	20-Ft	40-Ft
USMC 20-Ft	3	N/A
Army 40-Ft	2	3

7.2.8 Container Capacity of Lighters

The containers used in JLOTS II were loaded with dummy cargo, but the spectrum of weight was lighter than is expected in an actual operation. The effect of this in the test was that except for rare instances, there was no restriction, because of container weight, on the number of containers that were loaded on a lighter. The Causeway Ferry and LACV-30, however, do have characteristics that make them susceptible to weight overload. Also, the Causeway Ferry container load arrangement generally limits the number of containers on the forward section to allow space for crew functions and to give a lower draft at the bow to achieve better seaway and beaching performance. Table 7-15 gives, for each lighter type, the size of the average container load in JLOTS II, the maximum expected container capacity, and the cargo weight capacity of the lighter. The weight of containers carried cannot exceed the cargo weight capacity of the lighter.

TABLE 7-15 - LIGHTER CAPACITY

Lighter	Lighter Capacity*			
	JLOTS II Average Container	20-Ft Container Maximum	40-Ft Container Maximum	Short Tons Maximum
CSP+1	9	10	4	125
CSP+2	16	20	8	215
CSP+3	26	30	12	305
CF3	23	23	10	270
LACV-30	2	2	0	23
LARC-LX	2	2	1	60
LCU-1600	4	5	2	188
LCU-1466	6	8	3	187

CSP+1 - Causeway Section, Powered plus one Unpowered Section.
CF3 - Three-Section Unpowered Causeway Ferry.
*Number of containers cannot exceed weight capacity.

7.3 PLANNING FACTOR PROCEDURES

The expected performance values reported in Section 7.2 were used in a computer simulation model to develop planning factor information.

7.3.1 Simulation Model

A computer simulation of an AFOE/LOTS containership offloading operation was prepared to assist in the development of planning factors. The model keys on four major segments of the operation:

- Containership unloading
- Lighter movement
- Lighter unloading at the beach
- Truck movement and unloading at the Marshalling Yard.

7.3.1.1 Containership Unloading

One or more containerships may be undergoing offloading operations concurrently. The offloading means for each containership is one T-ACS-1 Crane Ship, or one TCDF, or two TCDF's. Separate from the model, a description of the containership loadout is prepared, using the Capacity Plan for the ship, to define the number of containers in each hatch in terms of how many are above the hatch covers, how many are below the hatch covers, how many are light weight 20-ft units, how many are heavy 20-ft

units, and how many are 40-ft units. Recognizing the location of the offloading cranes (T-ACS-1 or TCDF) relative to the containership, a number of topside containers, hatch covers, and below deck containers are assigned for offloading by each crane boom. If there are more containers to be offloaded than can be reached by the cranes from their original position relative to the containership, the containership is repositioned, and the above approach to crane assignment is repeated. This is repeated until the containership unloading is complete.

7.3.1.2 Lighter Movement

Lighter movement simulation will be described for the case using the T-ACS-1. The simulation using the TCDF is similar, but simpler.

The simulation currently recognizes eleven lighter types. They are:

- Powered Causeway Ferries (3 lengths)
- Unpowered Causeway Ferries (3 lengths)
- LCU, 1600 Class
- LCU, 1466 Class
- LCM-8
- LACV-30
- LARC-LX

Lighter movement is broken down into the following steps:

- Approach and Moor at the T-ACS-1
- Load Containers to Space or Weight Capacity
- Cast-off and Clear from the T-ACS-1
- Transit to the Beach Area
- Approach and Moor at the Beach Unloading Facility
- Unload Containers
- Cast-off and Clear from the Beach
- Transit to the T-ACS-1 Area.

7.3.1.3 Lighter Unloading at the Beach

The simulation will operate one or more of the following lighter unloading systems:

DeLong Pier (One or two lighter berths)

Elevated Causeway (One or two lighters berths)

Causeway Ferry Beach (RTCH unloaders; Numbers of berths as desired)
LCU/LCM Beach (LACH unloaders; Number of berths as desired)
Amphibian Beach for LACV-30 (Number of berths as desired)
Amphibian Beach for LARC-LX (Number of berths as desired)

The unloading system transfers the containers from a lighter to trucks. The DeLong Pier and the Amphibian Beaches allow a limited number of containers to be staged waiting for trucks, if necessary.

7.3.1.4 Truck Movement and Unloading at the Marshalling Yard

Two types of trucks are recognized in the simulation. One type may be loaded with only one 20-ft container. The other type may be loaded with one 40-ft container or two 20-ft containers. Once a truck has been loaded at the beach unloading system, it transits to the Marshalling Yard. After being unloaded, the truck transits back to the beach.

7.3.2 Model Logic and Input Requirements

Some of the more important features of the model logic are described in this section.

7.3.2.1 T-ACS-1 Logic

T-ACS-1 has six crane booms operating in three paired locations. Each boom has an assigned number of containers to handle. The important time is the time required for each container to be placed on a lighter from a crane location, and this depends on whether one or two booms are working at the location. The logic covers this situation.

T-ACS-1 has three lighter loading stations, corresponding to the three crane locations. They are numbered 2, 4, and 6, proceeding aft. The logic for selecting a lighter to be loaded at each station is developed to suit either Army or Navy cases. It is based on the following assumptions:

- Long Causeway Ferries are preferred Navy lighters
- LACV-30 lighters moored forward of another lighter is undesireable unless LACV-30 is the only type lighter in use.

Stations 2 and 4 should be used in combination, if possible. Therefore, lighter types are searched for in the following sequence:

CSP+3 (Causeway Section, Powered plus 3 Unpowered Sections

CSP+2

CF3 (Causeway Ferry consisting of 3 Unpowered Sections)

CF2

CF4

If none of these lighters are available, then Stations 2 and 4 may be used separately, with lighters searched for in the following order:

CSP+1

LCU-1466

LCU-1600

LARC-LX

LCM-8

LACV-30

Lighter order of selection for *Station 6 is:*

LACV-30

CSP+1

LCU-1466

LCU-1600

LCM-8

CF2

LARC-LX

CSP+2

CSP+3

7.3.2.2 Lighter to Beach System Logic

The model will search for available space for Causeway Ferries to unload at the DeLong Pier, Elevated Causeway, and RTCH Beach in that order. LCU-1466 unloading will be at the DeLong Pier or Elevated Causeway, in that order. LCU-1600 and LCM-8 will unload at DeLong Pier, Elevated Causeway, or LACH Beach. LACV-30 and LARC-LX unload only at their respective Amphibian Beaches.

7.3.2.3 Input Data Requirements

The description of containership loadout and crane boom assignments given in Section 7.3.2.1, provides a capability to examine the offload of any containership compatible with a mooring at T-ACS-1. The specified ship load arrangement and crane boom assignment is required input data. The other input data are the expected performance values in Section 7.2. Numbers and types of lighters and facilities are chosen as desired.

7.4 PROJECTED PLANNING FACTORS

Each of the Planning Factor Scenarios identified in Table 7-2 have been analyzed. For each, the total time to offload the containership has been determined as a function of the number of lighters of the specified type that are available. The number and type of beach offload facilities used was also tabulated. The results are displayed on Figures 7-4 through 7-16. The configuration of SS KEYSTONE STATE (T-ACS) is such that when Causeway Ferry lighters are used, short ferries are preferred at the aft loading station (Station 6). The simulation logic recognizes this and searches for available CSP+1 (P1) Causeway Ferries ahead of the longer ones for assignment to Station 6. To accommodate this, the Planning Factor Scenarios using Causeway Ferries were provided with a fixed number of P1's to serve Station 6. Longer Causeway Ferries, CSP+3 (P3), were varied in number to develop lighter quantity effects on containership offloading time. There was one exception to this (Figure 7-6), where only short Causeway Ferries were used. Comparing Figures 7-4 and 7-6, it is seen that using short Causeway Ferries alone requires 5.1 days to unload the ship versus 4.5 days for the combination of P-3's and P-1's.

Using Causeway Ferries, the AMERICAN LEADER (C6-S-1w) Class containership with 1001 containers can be unloaded in 3.7 days whereas the CV LIGHTNING (C5-S-73b) Class containership with 928 containers requires 4.5 days with the same number of Causeway Ferries. The reason for this is that the hatch arrangement for the C6-S-1w permits use of all six crane booms of the KEYSTONE STATE for a longer time than is possible with the C5-S-73.

The effect of the heavy container load in the C5-S-73b containership (272 heavy and 656 light containers) is seen by comparing Figures 7-4 and 7-5 where Causeway Ferries require 5.7 days to offload the heavy load

versus 4.5 days for the light load. Similarly, by comparing Figures 7-10 and 7-11, LACV-30's require 5.8 days to offload the heavy load versus 5.1 days for the light load. Figure 7-13 for the C5-S-73b containership, LCU 1466 lighters, and one DeLong Pier with two lighter berths shows the effect of a beach facility bottleneck. The curves never become horizontal because the DeLong Pier cannot keep pace with the KEYSTONE STATE. By adding more lighters, the ship gets unloaded earlier, but the lighter queue at the Delong Pier grows.

The Operational Requirement for the Auxiliary Crane Ship set a performance requirement for a 300 container per day cargo transfer capability in calm seas. The results of JLOTS II show that the 300 per day rate can be achieved when all cranes have access to a supply of containers and when lighters are available without delay. The normal course for unloading a containership results in some cranes exhausting the container supply they can reach before others. This leads to a diminishing throughput rate as ship unloading proceeds. This phenomenon is illustrated in Figures 7-17 and 7-18. Two additional points of significance may be interpreted from these Figures. First, since the "heavy" container load has only 272 truly heavy containers stowed in the lower tiers of the ship's holds, the first offload day handles primarily light containers for both the "light" and "heavy" loads. Therefore, the similarity in the container count for the first day is expected. Second, the temporary increase in throughput for Causeway Ferries (Figure 7-17, Day 5, Heavy Load) and for LACV-30's (Figure 7-18, Day 3, Light Load and Day 4, Heavy Load) is caused by starting to unload a previously unopened hatch where light containers are stowed in the upper tiers, or by warping the containership to a new position which permits a greater number of crane booms to work.

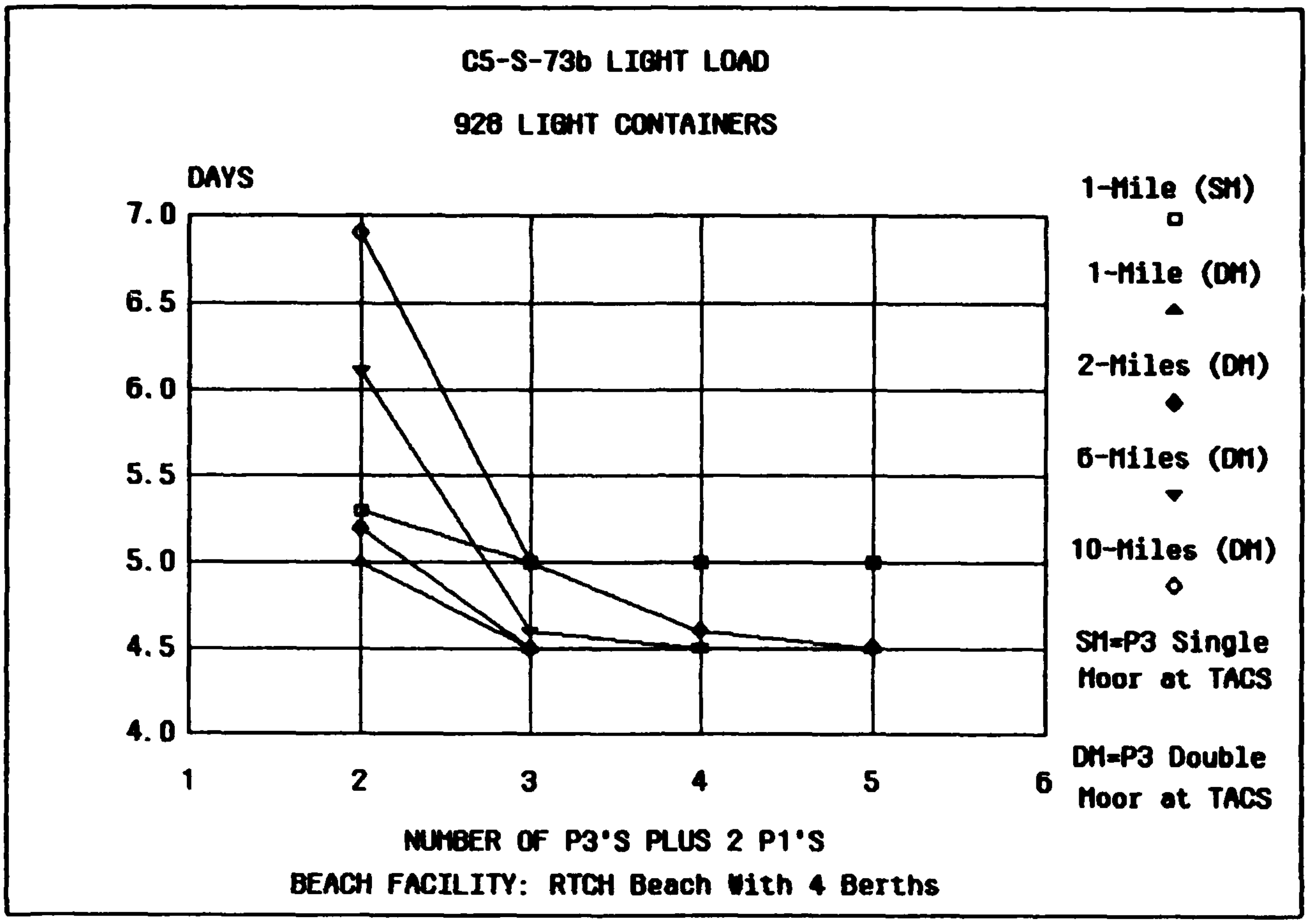

Figure 7-4 - Causeway Ferry Planning Factors for Lightly Loaded C5-S-73b Containership

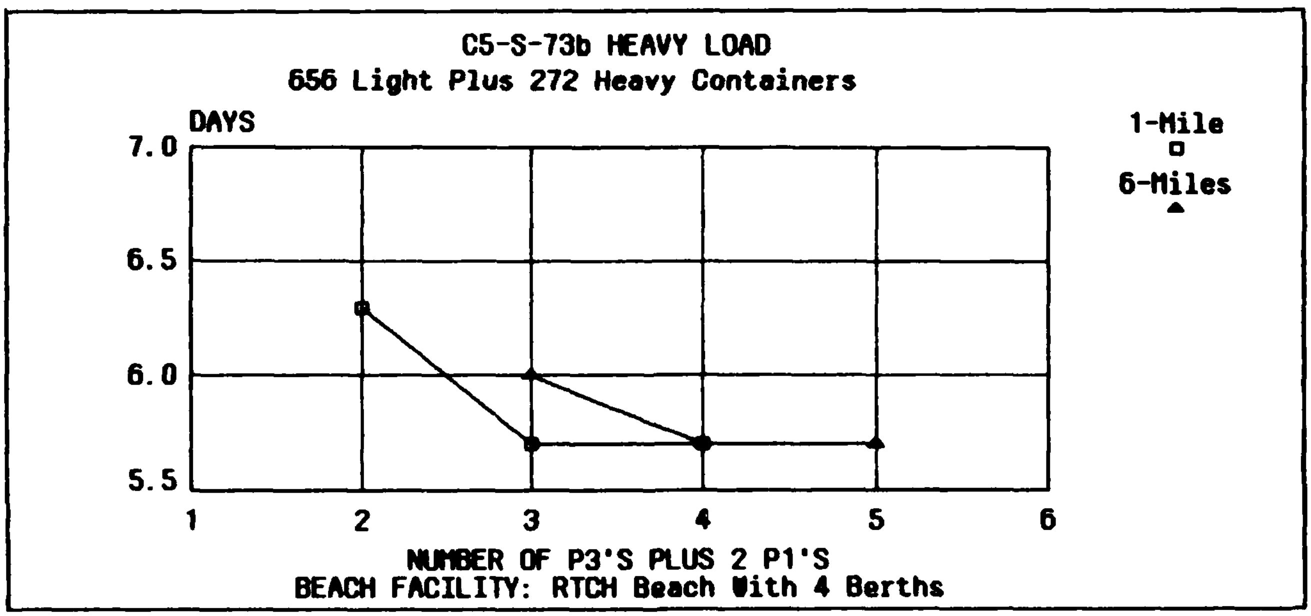

Figure 7-5 - Causeway Ferry Planning Factors for Heavily Loaded C5-S-73b Containership

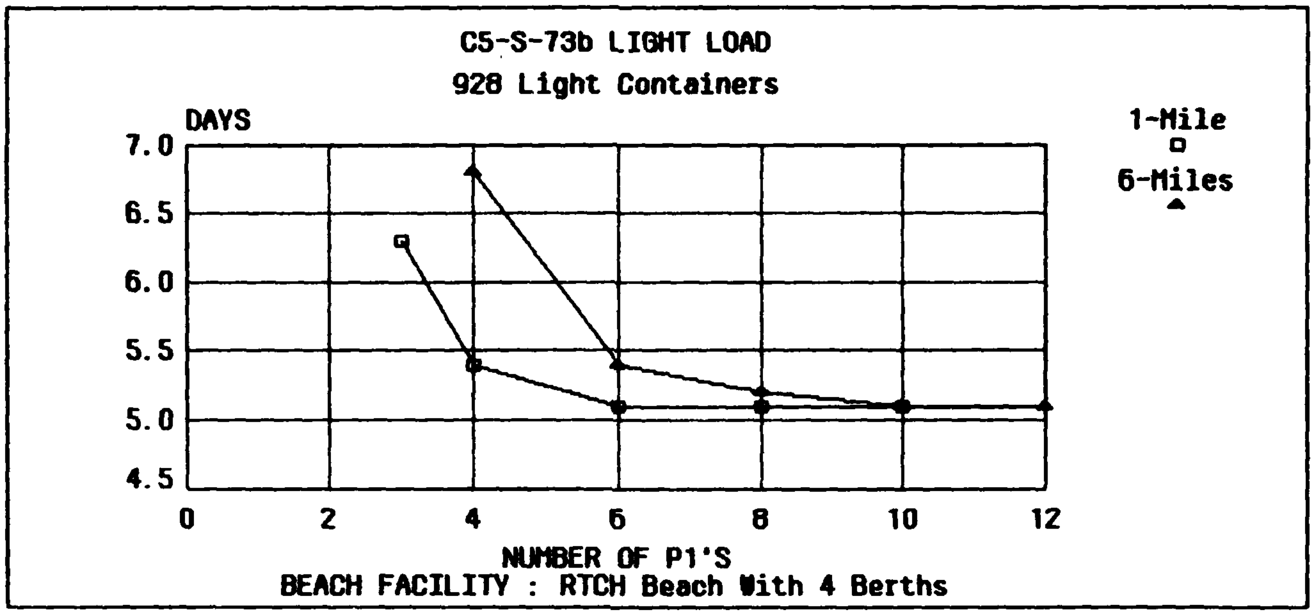

Figure 7-6 - Short Causeway Ferry (P1) Planning Factors for Lightly Loaded C5-S-73b Containership

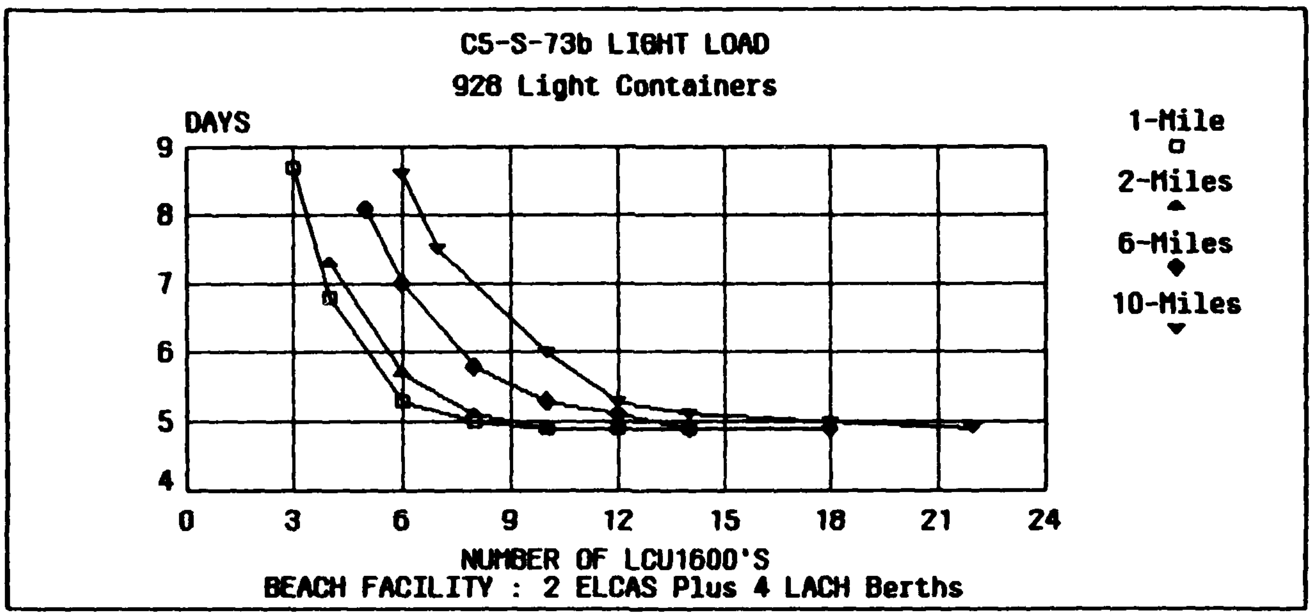

Figure 7-7 - LCU-1600 Planning Factors for Lightly Loaded C5-S-73b Containership with ELCAS and LACH Beach Facilities

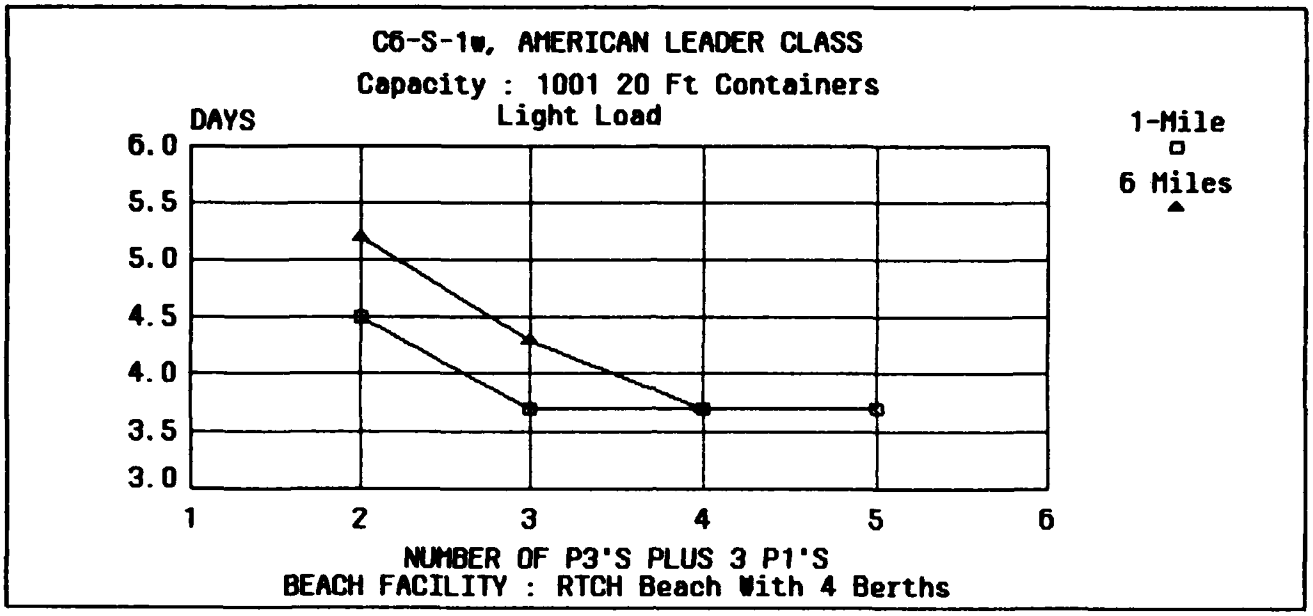

Figure 7-8 - Causeway Ferry Planning Factors for
Lightly Loaded C6-S-1w Containership

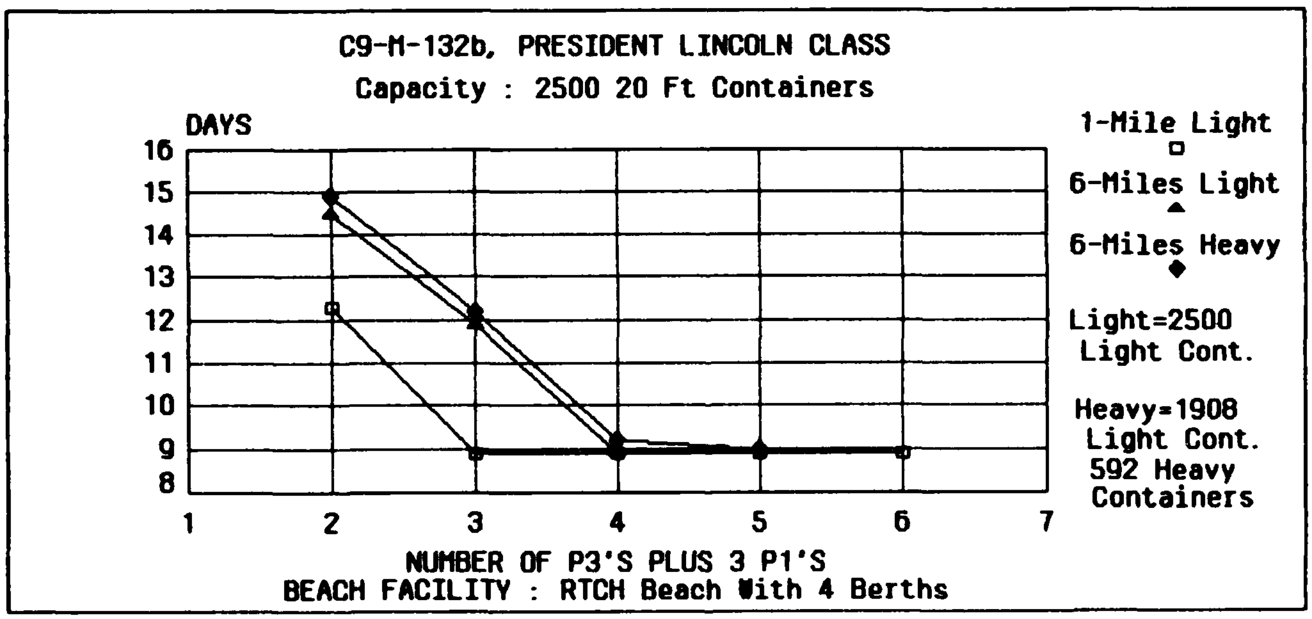

Figure 7-9 - Causeway Ferry Planning Factors for
C9-M-132b Containership

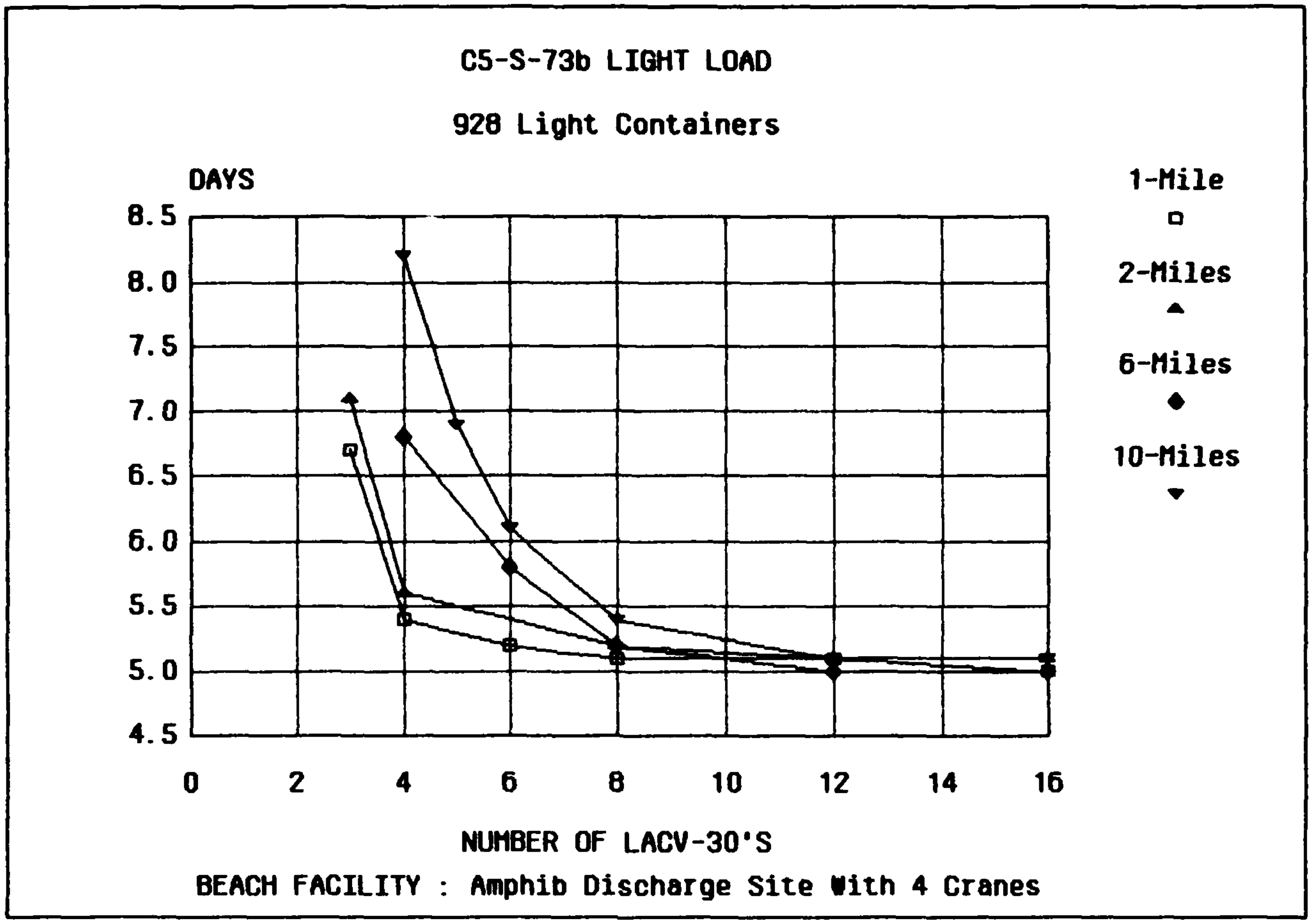

Figure 7-10 - LACV-30 Planning Factors for Lightly Loaded C5-S-73b Containership

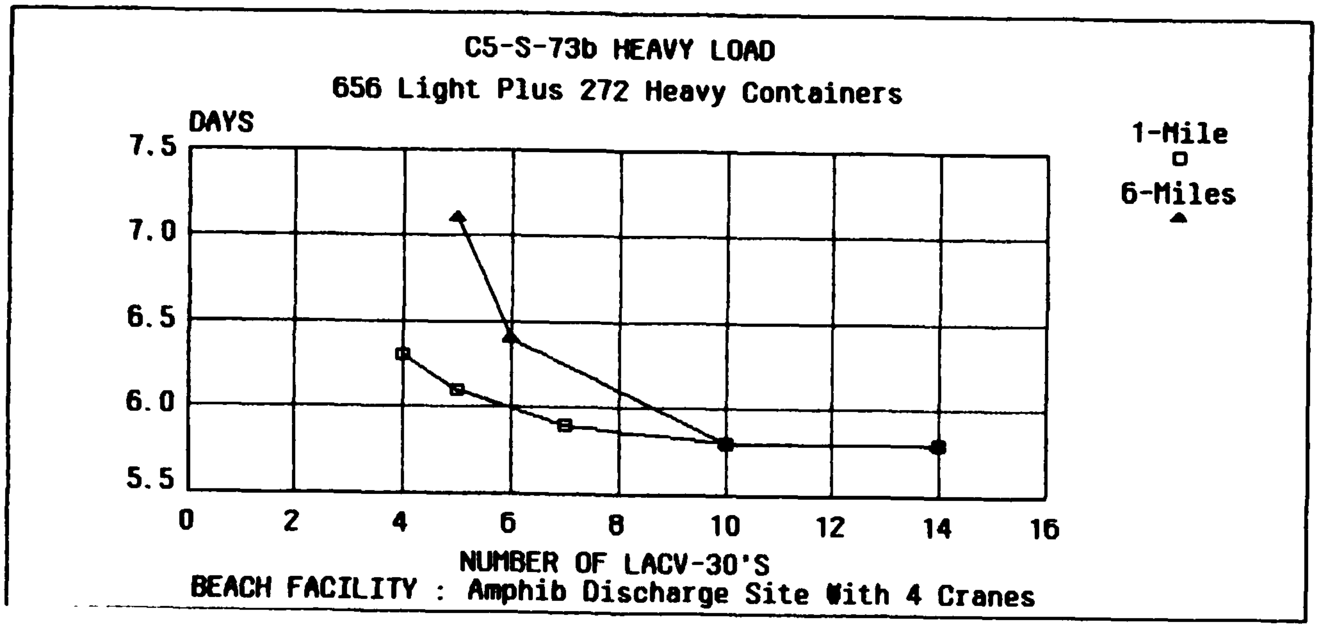

Figure 7-11 - LACV-30 Planning Factors for Heavily Loaded C5-S-73b Containership

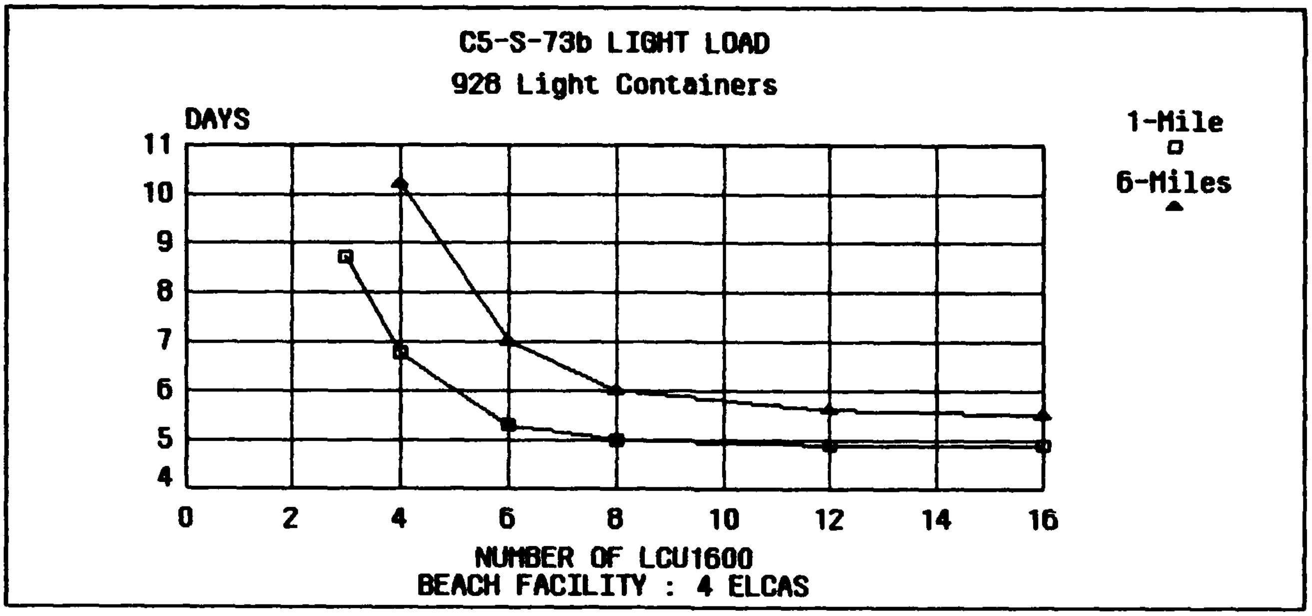

Figure 7-12 - LCU-1600 and ELCAS Planning Factors for Lightly Loaded C5-S-73b Containership

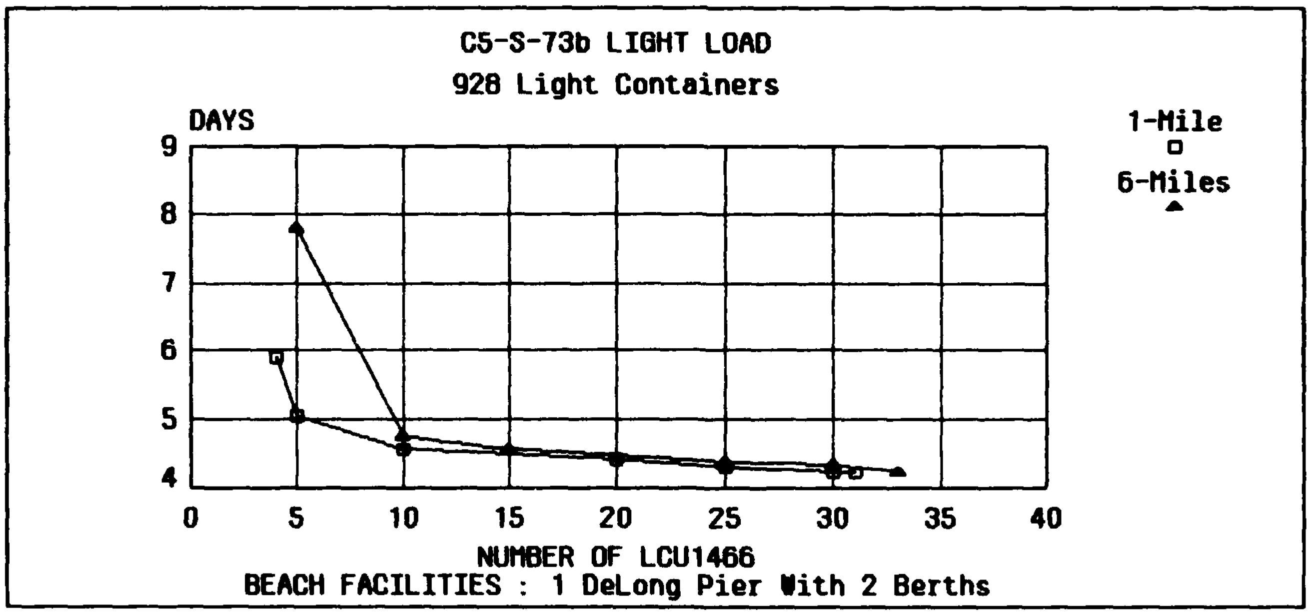

Figure 7-13 - LCU-1466 and DeLong Pier Planning Factors for Lightly Loaded C5-S-73b Containership

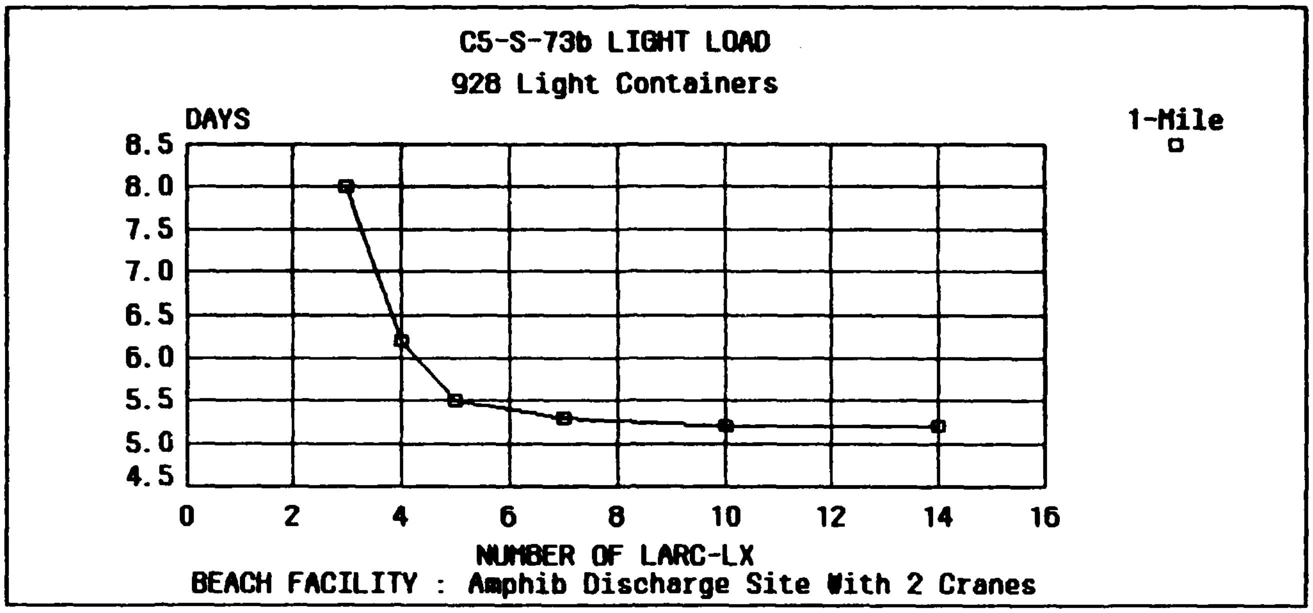

Figure 7-14 - LARC-LX Planning Factors for Lightly Loaded C5-S-73b Containership

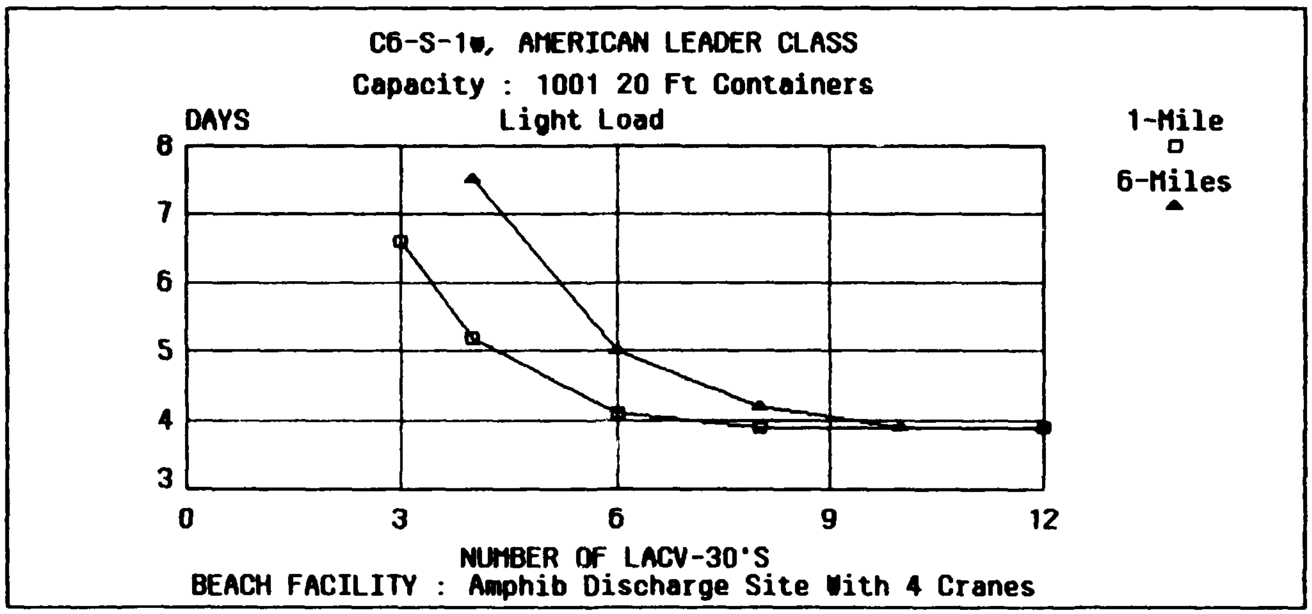

Figure 7-15 - LACV-30 Planning Factors for Lightly Loaded C6-S-1w Containership

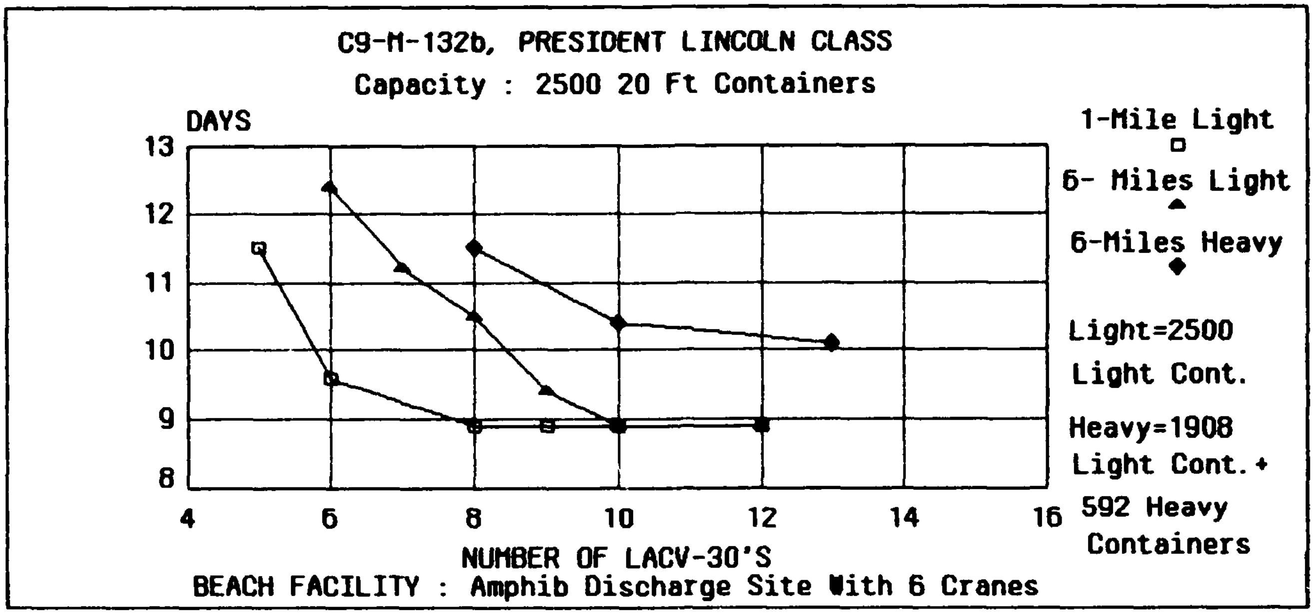

Figure 7-16 - LACV-30 Planning Factors for
C9-M-132b Containership

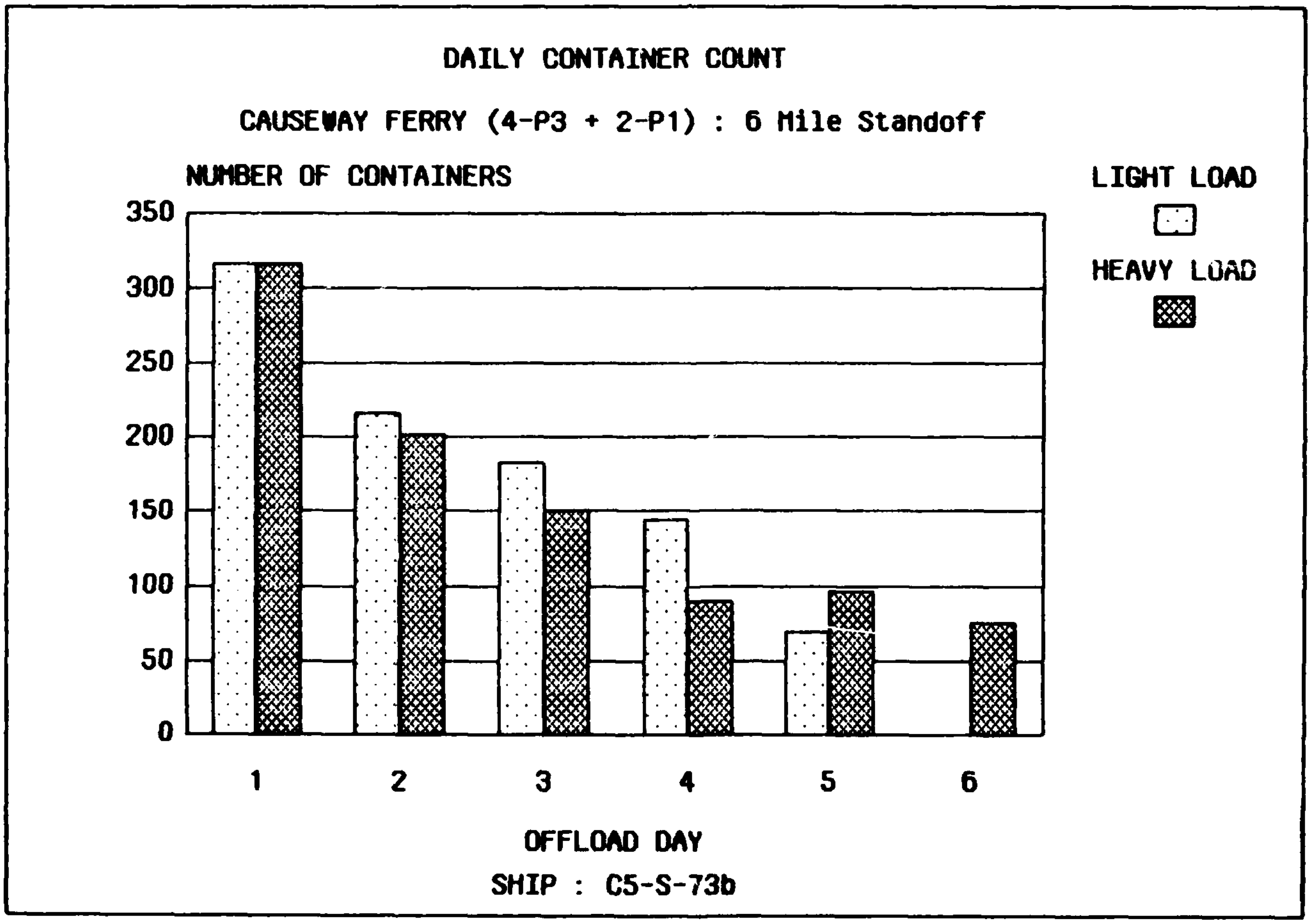

Figure 7-17 - Daily Throughput for Causeway Ferry Offload
of C5-S-73b Containership

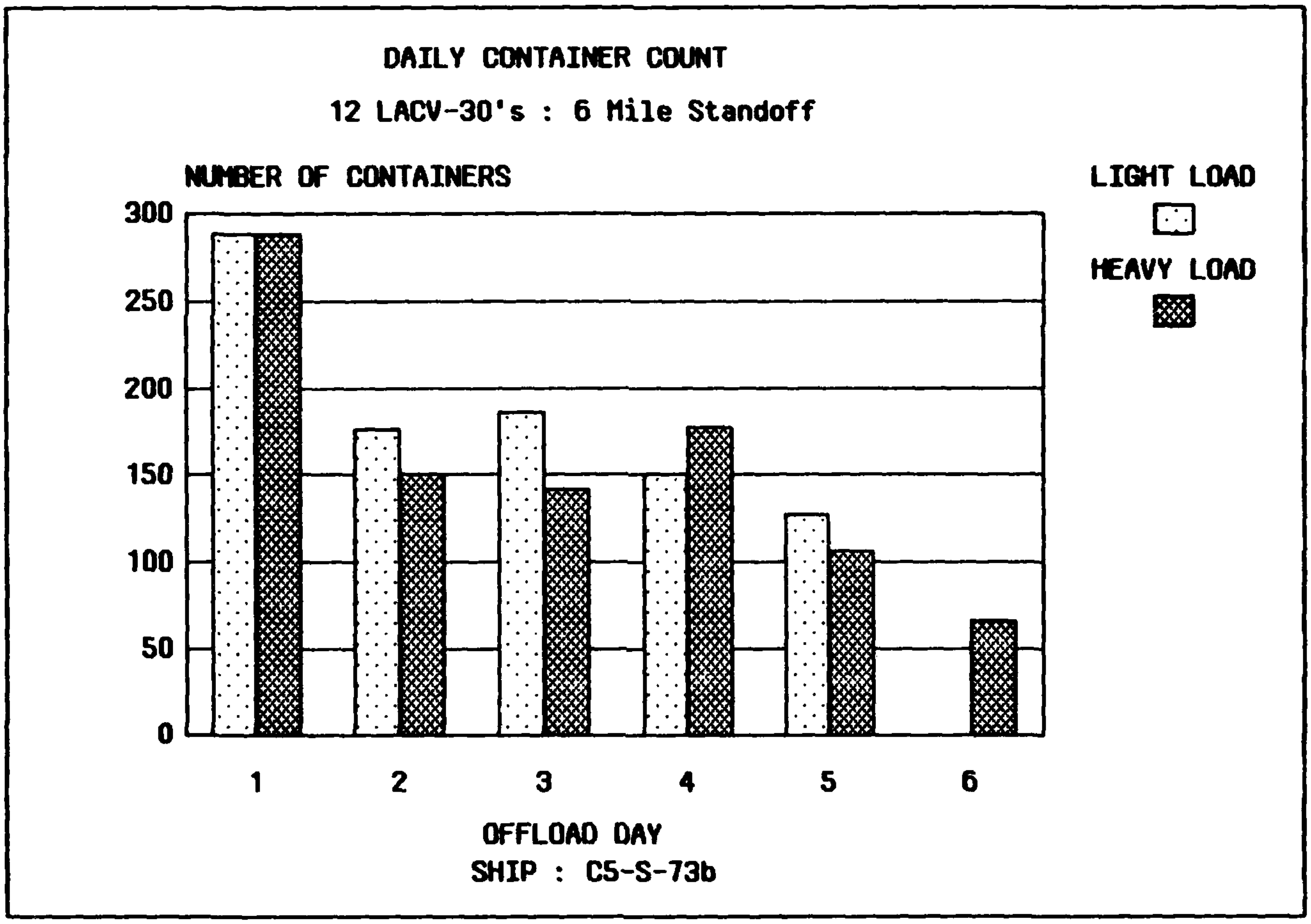

Figure 7-18 - Daily Throughput for LACV-30 Offload of C5-S-73b Containership

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Commanding General
4th Marine Amphibious Brigade
Attn: G4
Naval Amphibious Base, Little Creek
Norfolk, VA 23521

Commanding General
6th Marine Amphibious Brigade
Attn: G4
Camp Lejeune, NC 28542

Commanding General
7th Marine Amphibious Brigade
Attn: G4
29 Palms, CA 92278

Commanding General
9th Marine Amphibious Brigade
Attn: G4
FPO San Francisco, CA 96603

Commanding General
Marine Corps Development and Education Command
Attn: M&L Division
Quantico, VA 22134

Commanding General
Landing Force Training Command Atlantic
(Attn: Logistics/Embarkation)
Naval Amphibious Base, Little Creek
Norfolk, VA 25321

Commanding General
Landing Force Training Command Pacific
(Attn: Embarkation)
U.S. Naval Amphibious Base, Coronado
San Diego, CA 92155

Advance Amphibious Study Group
Headquarters, United States Marine Corps
Attn: COL Conatsur
Quantico, VA 22134

Director
Marine Corps Operational Test and Evaluation Activity
Quantico, VA 22134

Commanding Officer
2nd Landing Support Battalion
2nd Force Service Support Group (Rein)
Camp Lejeune, NC 28542

Commanding Officer
1st Landing Support Battalion
1st Force Service Support Group (-)
Camp Pendleton, CA 92055

Commanding Officer
3rd Landing Support Battalion
3rd Force Service Support Group (-)
FPO San Francisco, CA 96604

Headquarters
U.S. Air Force (LET)
Washington, DC 20330

Headquarters
U.S. Air Force (XOORE)
Washington, DC 20330

Headquarters
Military Airlift Command (TR)
Scott Air Force Base, IL 62225

Headquarters
Tactical Air Command (LGT)
Langley Air Force Base, VA 23665

Headquarters
U.S. Air Force, Europe (LGT)
APO New York, NY 09012

Headquarters
U.S. Air Force, Pacific (LGT)
Hickam Air Force Base, HI 96853

Headquarters
Air Force Logistics Command (DST)
Wright Patterson Air Force Base, OH 45433

Headquarters
Air Force Systems Command (LGT)
Andrews Air Force Base, DC 20334

Headquarters
Strategic Air Command (LGT)
Offutt Air Force Base, NE 68113

Headquarters
Air Force Reserve (LGT)
Robins Air Force Base, GA 31098

Headquarters
Space Command (LGOT)
Peterson Air Force Base, CO 80914

Air Force Logistics Management Command (LGT)
Gunter Air Force Base, AL 36114

Air Force Operational Test and Evaluation Center (JT)
Kirtland Air Force Base, NM 87117

Air Force Institute of Technology (LSM)
Wright Patterson Air Force Base, OH 45433

3760 TCHTG/TTGBT
Sheppard Air Force Base, TX 76311

Commandant
U.S. Coast Guard
21090 Second St., SW
Washington, DC 20593

Commander
Fifth Coast Guard District
431 Crawford St.
Portsmouth, VA 23705